Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLII. NEW YORK, SATURDAY, DECEMBER 19, 1903. No. 25.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office. In requesting your address changed give OLD as well as new address.

Copyright, 1903, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 19, 1903.

CONTENTS.

Editorial 993
Work of the Carnegie Institute 996
Protected Third Rails 996
Mr. Westinghouse on the Third Rail Problem 996
Montreal, the Greatest Centre of Transmitted Power—III. By Alton D. Adams 997
Conductivity of Mercury Vapor. By Peter Cooper Hewitt 1000
German Gas Engine Power Stations. By Frank C. Perkins 1002
Physical Equipment of American Central Stations 1004
The Winter-Eichberg Single Phase Railway System 1006
New Telephone Patents 1008
Recent Electrochemical Developments 1008
Engineering Features of the St. Louis World's Fair. A General Review.. 1009
New Year World Time Signals 1010
Peat Coal by Electrical Process 1010
Mr. Westinghouse on the Steam Turbine 1010
Convention of the Interstate Independent Telephone Association..... 1011
Electrical Production in Germany 1013
Ohio Independent Telephone Traffic Association 1014
The Year's Patent Record 1014
Current News and Notes 1014
LETTER TO THE EDITORS:
Heating Handles of Automobiles and Cars. By R. A. Fliess 1015
Digest of Current Electrical Literature 1016
New Books. 1020
Automatic Track Switch for Street Railways 1021
Adjuster for Incandescent Lamps 1021
Current Interrupter 1022
Electric Motor Starters and Controlling Panels 1022
The Evolution of the General Electric Transformer 1023
New Switch Pattern Set 1024
New Submarine Cable Plant 1024
Small Multipolar Motors 1024
News of the Week. 1025

THE CENTRAL STATION INDUSTRY.

We complete in this issue our review and summarization of the interesting and valuable figures presented in the bulletin just issued by the United States Census Office on the central electric light and power stations of the United States. In these statistics, collated with great care and thoroughly sifted by the department in Washington, we have a digest of all the important data and features connected with the electric light and power industry, so far as it is carried on by central station companies and municipal plants. These data disclose, on analysis, a great many further facts, themselves of importance and significance. It is remarkable that twenty-five years of the industry should have gone by before such a compilation of statistics became possible, and it was, indeed, high time that the work was done. There have, of course, been many voluntary attempts in this direction of a creditable nature, but it stands to reason that only a collector of such information vested with the authority of the government, could do the work accurately and completely.

The figures will no doubt be studied carefully and closely by our readers, and have already been commented upon in our columns. One of the chief points which emerges is the extraordinary manner in which central station industry has overtaken gas lighting; and the victory of electricity is the more striking when it is borne in mind that the figures included in this bulletin take no account of the work embraced in some 50,000 isolated plants which are believed to constitute a development of electric lighting and power fairly equal to that in the central station field. But taking the central stations alone, it is impressive to note that the gas industry dating back to 1806, has already been passed in investment, income, labor employed, and other respects, by the industry which virtually began only in 1879. Moreover, the competition of electricity has, during these twenty-five years, been of the greatest benefit to the gas industry, and each has reacted and interacted on the other in a very helpful manner. To us one of the most encouraging signs of the times is that in spite of the vast and radical improvements seen in electric lighting, no finality of principle or method or apparatus is in sight, but we have to-day as great promise of advances in economy and efficiency, as well as in general utility and safety, as when Brush and Weston and Edison and Elihu Thomson did their great pioneer work a quarter of a century ago.

CONDUCTIVITY OF MERCURY VAPOR.

Elsewhere we print an article by Mr. Peter Cooper Hewitt giving the result of elaborate experiments on the conductivity of mercury vapor, which forms a notable contribution to scientific literature both in subject and as an example of skillful investigation. The difficulties in the investigation of the electrical conductivity of gases and vapors are very great, owing to the numerous effects that may intervene to vitiate the results. The most prominent of these are the positive and negative electrode effects, which were entirely eliminated in the arrangement employed by Mr. Hewitt in the measurement of the conductivity of the vapor. The results arrived at in the investigation are of increased interest for the reason that any conclusions drawn from them should apply generally to all gases and vapors. The particular deduction by Mr. Hewitt from his work is that in the case of a vapor tube employed as a source of light, there is a

point of maximum light efficiency corresponding to a fixed relation between the vapor density and the current. Another point of the highest interest is the observed effect on a vapor column of magnetic force, which increases enormously the resistance at low densities, and also alters the spectrum of the vapor. One curious fact in connection with vapor conduction is that Ohm's law is applicable notwithstanding that for fixed conditions the voltage is constant, the anomaly being due to the fact that the resistance decreases as the current increases, this being directly contrary to the case of electrical conduction in solids. The data presented in the curves accompanying the article will be of the highest interest to physicists; and while the investigation was doubtless undertaken by Mr. Hewitt, particularly in the interest of the mercury vapor lamp, he deserves the highest commendation for having made it so general that the results form a valuable contribution to physics in general. The name of Hewitt has always been connected with disinterested exhibitions of public spirit; and in this article we have but one more evidence of a desire to contribute without reservation to the common store of knowledge useful to the community at large.

The Third Rail Agitation.

Frequent accidents of late, in Brooklyn and Chicago, and, even more than that, the indiscriminate agitation of the subject by some of the daily New York newspapers, have aroused in the public mind a feeling of anxiety and uncertainty as to the perils of the third rail on elevated railroad structures. With regard to this subject, some data are given in our columns this week, but the most interesting contribution to the discussion is that by Mr. George Westinghouse, whose vigorous and direct utterances, as usual, immediately command attention. While other electrical engineers and inventors are wrestling with the problem of protecting the third rail or of leaving it so unprotected that if anything happens it is innocuous, Mr. Westinghouse declares boldly his belief that there will be a complete revulsion of feeling in the profession as to the necessity for the third rail, and that the overhead wire will again be recognized not only as a possible way of conveying current to the elevated cars, but the preferable way of doing so. We refer our readers to Mr. Westinghouse's very interesting statement of the case, which loses nothing from his logical and practical analysis of the various questions involved. The overhead wire has, indeed, a great many claims upon public consideration, whether for the elevated system or for such a thoroughfare as West Street, New York, where practically nothing else could operate; and it will be quite interesting to see how the technical developments of the situation support Mr. Westinghouse's views and contentions. We are all hoping that the Manhattan Elevated system may go through this winter without trouble, for a repetition of last winter would break the hearts of most New Yorkers, to say nothing of costing some of them their lives. The Manhattan Elevated management has shown itself so able and farsighted, as well as liberal, we may trust it to make the *volte face* in regard to the third rail in case it should be demonstrated that the change is necessary.

Incidentally, Mr. Westinghouse makes an important point as to the conditions applying to the underside of the cars. Even if all the cars were all metal, the contiguity to the third rail is not calculated to inspire one with an utter sense of safety. Besides, the manner in which apparatus has of late years been loaded on the underside of the cars and on the trucks, is something extraordinary, with resultant complications of unsystematized wiring. An improvement there seems decidedly possible, and Mr. Westinghouse offers a pertinent suggestion along those lines also. These problems are, indeed, worthy the best engineering thought of the time.

Alternating Current Traction.

It is a curious thing that upon the very heels of the great New York Central contracts should come authoritative announcements, both here and abroad, of the development of successful alternating-current motors specially fitted for interurban and other serious service. It would be strange, indeed, if the first great railroad plant should be the last great direct-current traction system. We are not disposed to take the perfervid view of some of our foreign contemporaries that both direct-current and polyphase motors are to give way instanter to simple series-wound, single-phase motors, but it is undeniable that Lamme in this country and Finzi and the Union Elektricitäts Gesellschaft abroad have produced alternating-current railway motors of very remarkably advanced design. We have long held, against the popular opinion, that the common scheme of distributing power for railway use from rotary converter stations is unwieldly and often uneconomical, and must sooner or later be replaced by an alternating distribution carried at least clear up to the car, but the sudden activity in this line of work is more than we expected at the present moment. It looks now as if the alternating-current contingent proposed to take the aggressive and to force the fighting from now on, and the battle will be most interesting to watch. The new motors are intended not only for the interurban work, where they have been most needed, but for the ordinary work of electric traction, and their competition will thus be doubly formidable. Their practical working properties have yet to be proved on a commercial scale, but the experimental results are certainly highly promising. Sparking and low power factor at starting are the faults most to be feared, yet it is noteworthy that the tests of the Finzi motor show during acceleration an output in volt-amperes not greatly in excess of that demanded by a standard direct-current motor.

Grouping of Cells to Obtain Maximum Current.

On page 955, of our last week's number, we printed an article, by Dr. K. E. Guthe, on the above subject, which introduces several interesting considerations. As pointed out in the article, the solution of the general problem of maximum current from a battery of voltaic cells is by no means recent, but goes back at least as far as 1878. The time-honored rule is that the grouping must be such that the internal resistance of the battery shall be equal to the external resistance. Dr. Guthe shows, however, that this proposition is only true when the cells admit of grouping into a simple or complete series-parallel arrangement, under the definition of the rule. He analyzes some simple cases to show the limits within which the reservation must apply.

If the working e.m.f. of a cell be denoted by e volts, and its working internal resistance of the cell by r ohms, the power which the cell will develop on short-circuit will be e^2/r watts. In most primary voltaic cells this represents a perfectly realizable condition. In secondary cells of the lead type, the condition is not, or should not be, realized. This amount of power is the maximum that a cell can, under any condition, develop, and has been called the "electrical capability" of the cell. The efficiency of the cell under short-circuit, or when developing this electrical capability, is zero. If, on the other hand, the cell be set to work on an extremely large external resistance, its efficiency will be nearly 100 per cent.; but the power developed will be microscopically small. Midway between the preceding two conditions, or when the efficiency is 50 per cent., the cell will develop the maximum external or available power, and the load, if it consists of a simple resistance, will have a resistance equal to r. The power developed by the cell will then be half of

its capability, and the externally available power half again of this, or one-quarter of the capability.

The capability of a battery of N similar cells will be N times the capability of one cell. If, therefore, a certain amount of power is required from a battery, say at the terminals of a small motor, the minimum battery, or battery of lowest first cost in cells, that will supply this power, is a battery whose capability is four times the required power. The said battery will deliver this power at 50 per cent. efficiency, whether in simple parallel grouping, or simple series grouping, or in any complete arrangement of parallel series. If the translating device is a resistance, the grouping must be such as admits of a complete series-parallel arrangement having a total internal resistance equal to the said external resistance. If the translating device be a motor, the internal resistance of the minimum battery will be considerably greater than that of the motor, and the grouping of the battery will be determined by the voltage, or winding, of the motor. In all cases, however, the ideal solution calls for 50 per cent. efficiency.

The same rule applies also to dynamos except that no large dynamo can be operated at as low an electrical efficiency as 50 per cent. It was a dim and imperfect recognition of this rule that retarded the development of the dynamo in early days. Investors not only believed correctly that the minimum dynamo that would supply a given power must work at 50 per cent. efficiency, but they, moreover, erroneously believed that the best efficiency of a dynamo was 50 per cent. Under practical conditions, the minimum dynamo that will supply a given power has a capability of from ten to forty times that power, and works at an electrical efficiency of from 90 per cent. to 97½ per cent. In other words, the full-load output of a direct-current dynamo is from 10 per cent. to 2½ per cent. of the capability, according to the size of the machine, and the electrical efficiency is correspondingly 90 per cent. to 97.5 per cent. The minimum dynamo that would yield the power would be theoretically of a capability four times the power, working at an electrical efficiency of 50 per cent., if we could dissipate so much heat in the dynamo, and also be content to operate at so low an efficiency.

THE PROPOSALS FOR ACTION OF THE INTERNATIONAL ELECTRICAL CONGRESS OF ST. LOUIS.

The American Institute of Electrical Engineers, at its annual convention this year, at Niagara Falls, read and discussed two papers upon subjects which might be brought to the consideration of the Chamber of Government Delegates of the forthcoming International Electrical Congress at St. Louis in September, 1904. One of these papers, by Prof. Carhart, was entitled "The Legalized Standard of Electromotive Force." It sets forth the propositions, first, that the value of the e.m.f. of the Clark cell at 15° C. is nearer to 1.433 than to the official value, 1.434, adopted by the Chicago Congress; and, second, that the cadmium cell is a preferable standard to the Clark cell. The other paper was by Dr. Kennelly and refers to electrical units, electrical nomenclature and to international standardization. These papers have been reprinted, by resolution of the Institute, and distributed among technological institutions, with the object of eliciting the views on these subjects of electricians and electrical engineers all over the civilized world. It is now recognized that an Electrical Congress so far as concerns its official actions, is unlikely to take action upon any matter which may be promulgated there for the first time, or which may only recently have been promulgated. Experience has shown that an International Electrical Congress may take official action on some question of international electrical interest, upon which a consensus of opinion has been reached through the medium of discussion in the transactions of technological societies, or in the technical journals; but it is unreasonable to expect that the seal of international approval shall be set by a congress upon a question that has received no previous general consideration or discussion.

Our esteemed contemporary, the *Elektrotechnische Zeitschrift*, alludes editorially in a recent number to these Institute papers, and opens its correspondence columns to the discussion of the questions considered. The facts are clearly and fairly stated by the editors, who treat the proposals considerately and judicially. There is only one detail in their presentation of the case with which we feel inclined to differ. Whereas they intimate that the units "maxwell" and "gauss," adopted by the Paris Electrical Congress of 1900, have come but little into use in America, we believe that a careful consideration of recent electrotechnical American literature will satisfy the reader that these units have come into fairly extended use on this side of the Atlantic, although it is admitted that they have not come into universal use. The editors of our German contemporary also point out that the question whether a name for an electromagnetic unit will, or will not, come into general use, depends in a great measure whether the unit enters into business dealings. The volt, ampere, ohm and watt come frequently into contracts and into specifications, whereby their general adoption is promoted. The magnetic units and magnitudes are rarely made the subjects of contracts or specifications, and, consequently, they do not spread so rapidly, or come into the same extensiveness of use, as their more commercial brethren. Nevertheless, we consider it as almost axiomatic, that every unit of importance in our fundamental C.G.S. system of units should have a name to recognize it by. An anonymous unit is an anomalous unit. How hopeless it would be to speak of a 50-gramme weight, as a weight of 50 C.G.S. units of mass; or a metric ton as 10^6 C.G.S units of mass. A C.G.S unit of magnetism is as worthy of a name as a gramme. Give a unit no name, and one might as well hang it out of reach for all purposes of practical utility.

Granted that it is desirable to christen and baptize the heathen C.G.S. units, the question of ways and means becomes of imposing dimensions. Only the units of length, area, volume, mass and time in this system have titles. All the rest, with the exception of inductance, energy, magnetic flux, and flux-density, pertain to the ranks of the vulgar and unnamed. To give names of departed eminent electricians to this list is not only to strain the memory, but also to strain the list of the celebrated scientists who have already joined the great majority. The only hope seems to be to adopt a plan similar to that suggested in the A. I. E. E. paper above referred to, and apply a suitable prefix to a practical unit in order to designate the corresponding absolute unit. There is certainly a limit to the practical use of the practical, or volt-ampere-ohm system of units. In this system the unit of length is the earth quadrant, and all quantities involving length, such as gradients, or intensities, must introduce the quadrant, or else involve a numerical factor, in order to maintain the system of equations. Thus the unit of inductance in the practical system—conventionally a length—is inevitably the henry or earth quadrant, as distinguished from the centimeter. Also, in the practical system, the value of magnetic force or gradient of magnetic potential would inevitably entail magnetic potential units per quadrant, as distinguished from gilberts per centimeter. There is an objection to gradients of potential per quadrant in a dynamo of a few meters in size. For this reason, and also because we all learn the science of electromagnetics in the C.G.S. system, it is important to be able to use the C.G.S. system, when desired, by christening all of its principal units.

Work of the Carnegie Institute.

At Washington, on December 8, the second annual meeting of the trustees of Carnegie Institute was held. There were two sessions, with a dinner following. Andrew Carnegie, who set aside the fund for the institution, was present, as also was Alexander Agassiz, of Cambridge, Mass., the president of the National Academy of Sciences. The report submitted on the proceedings of the last year was supplemented by explanatory statements by Dr. Gilman, the president of the institution, and by Dr. Walcott, the secretary. Mr. Carnegie made a brief address, in which he commended the work done and talked generally of the aims of the institution. The report on the year's operations showed sixty-six grants made by the executive committee for scientific research, involving an aggregate of $150,000, and recipients representing every part of the United States and the smaller colleges as well as the large universities, observatories, and laboratories. Twenty-five research assistants were appointed.

The morning session was devoted mostly to a discussion of several large projects. No conclusion was announced. The trustees authorized an aggregate expenditure of $373,000 in grants for scientific researches and $40,000 for publications during the ensuing year. The following officers of the board of trustees were elected: Chairman, Dr. John S. Billings, New York; vice-chairman, Elihu Root, Secretary of War; secretary, Charles D. Walcott, director of the Geological Survey. Vacancies on the board were filled by the election of John Cadwalader, of New York, to succeed Abram S. Hewitt, deceased; Cleveland E. Dodge, New York, to succeed William E. Dodge, deceased, and Judge William Wirthowe, New Orleans, to succeed Justice Edward D. White, resigned. Secretary of State John Hay was chosen as a member of the executive committee in the class of 1905 to succeed Mr. Hewitt, and Dr. S. Weir Mitchell and Carroll D. Wright were re-elected for three years as members of the executive committee.

Protected Third Rails.

A letter that has been sent to the New York State Board of Railroad Commissioners by E. P. Bryan, vice-president of the Interborough Company, on the subject of protection from the third rail, is as follows:

"I will state for your information that our engineering force has been at work for some months to devise some practicable plan for protecting this third rail. Any plan which completely protects the third rail involves a change in the character of a contact shoe used, and I can easily explain to you that it is no trifling matter to do this and not undertake something experimental, and the Manhattan road is the last place in the world to try experiments of this nature.

"Your board is, of course, aware of the fact that the third rail has never been successfully covered anywhere, and is not now either in Chicago, Boston, Paris, or Brooklyn. We have plans that are now being carefully considered, and with which experiments will be made, but it is impossible to do anything toward the protection of this rail during the present winter. I shall be glad at any time to discuss the difficulties connected with this with your commission, and I beg to advise that we have not at present anything with which we are sufficiently satisfied to submit to you.

"We have installed additional telephone stations so that now every station on our line on both sides is being connected independently with the power station and the sub-stations, and we have written Commissioner Sturgis that with proper understanding between the Fire Department and this company we can guarantee that the interval between notice from the Fire Department of their desire to use the structure and the time of shutting off the current will be very brief indeed, which will be much better than any protection to the third rail. Of course, whenever the Fire Department comes upon the structure and places the hose across it immediately stops traffic, and the current should be shut off, and this can be done."

Mr. William Leary, secretary of the New York Fire Department, has sent the following letter to the State Board of Railway Commissioners concerning the protection of firemen from the third rail while working on the elevated railroad structures:

"I am directed by the commissioner to acknowledge receipt of yours of the 10th inst. enclosing copies of letters from the Interborough Rapid Transit Company as to the third rail on the Manhattan structure, and from the Brooklyn Heights Railroad Company as to the third rail on the Brooklyn elevated railroads, and to say that while the commissioner recognizes the advantage of cutting off the current, he feels it his duty to say that this will not meet the requirements for the safety of the Fire Department.

"Any delay in cutting off the current would endanger the lives of the men, who must begin their work upon the elevated structure instantly upon their arrival; otherwise, fires might escape their control. They have, of course, no means of knowing whether the current has been cut off, or whether the rail is dead or alive."

Secretary Leary holds that the Fire Commissioner, unlike Vice-President E. P. Bryan, of the Interborough Company, considers this matter to be of intense public interest, and in no sense a private affair.

Mr. Westinghouse on the Third Rail Problem.

A most interesting communication by Mr. George Westinghouse to the New York *Evening Post* deals with the problems of the third rail. We quote it in extenso below:

"Replying to your letter of December 12 concerning the third-rail question, I think the following points will be generally admitted:

"(1) That the operation of the elevated trains by electricity has been an undoubted success, and an enormous advantage to the traveling public, notwithstanding the fact that the continuous third rail has been employed to supply the current.

"(2) That the deaths and injuries to passengers and employees, considering the number of people involved, compare most favorably with any other railway operation in the world.

"(3) That if a third rail charged with an immense power of electricity and located upon the surface near the other rails is to be used for the supply of electricity to the trains, then there will always be a source of danger to those who have occasion to come near such third rail, and in addition there will always be a great source of danger due to the fact that a car may be derailed, or that some iron material may become detached and make a short-circuit between such third rail and the train.

"(4) That the third-rail danger may be lessened by the subdivision of the third rail into sections with provision for the automatic supply of the required amount of current to each section only as required, but that such arrangement will only minimize the third-rail danger.

"(5) That such third-rail danger may be entirely obviated by resorting to the use of overhead conductors, for which the elevated structure is peculiarly suited.

"(6) That there never was a good reason why the overhead wire should not have been used.

"In support of these last two propositions, it may be stated that the third rail is impossible for use on main railways at important junctions and terminals; that the Pennsylvania Railroad does not propose to use the third rail in its underground work between New Jersey and Long Island; that the overhead wire was used at the Zossen experiments in Germany, when a speed of 130 miles per hour was obtained; and, finally, that the New York Railroad Commissioners have recently declared that they would not permit the use of a third rail on interurban lines crossed many times by highways.

"It may seem to be heresy to advocate the use of the overhead wire, but I venture to predict that there will be a complete revulsion of feeling on this point. When I speak of an overhead wire, I do not mean the slight construction which has prevailed, and the breaking down of which has occasioned trouble, but a substantial engineering arrangement so erected that it would, in fact, not be an offence to the eye. It is obvious that the use of an overhead trolley, with the removal of the third rail, would make impossible the present risks of short-circuits between the car or parts of the car and the third rail; but it would leave other questions yet to be settled; namely, first, the proper application of the electric apparatus to those cars, so that in no event could the passengers be frightened by a short-circuit visible to them, and this means that all of the wiring and electrical apparatus would have to be located beneath the bottom of a fire-proof car and with no wires carrying large currents above the floors or near the ends of the cars which might be damaged by accident.

"I am satisfied, from my conferences with railway officials, that they are moving in the right direction and giving this subject the attention it deserves; but it must be borne in mind that it has required experience to demonstrate what is necessary for safety."

Montreal, the Greatest Centre of Transmitted Power.—III.

BY ALTON D. ADAMS.

THE Chambly power plant and transmission system, as it now exists and as described below, is the result of reconstructing and doubling the capacity of the old Chambly plant, which operated at 12,000 volts, two-phase currents, generated by the four inductor generators now in the power house. In order to bring it to its present efficient condition it was necessary to reconstruct the old water-wheels, install the new wheels, rewind the Stanley inductor generators for lower voltage, install the new General Electric generators, install step-up and step-down transformers, reconstruct the transmission line and install the 22,500-volt cables included as a part of it, and build the new receiving station in Montreal. That this work was all carried on without depriving the power company of the output of the old plant reflects much credit upon Mr. Gossler and his operating staff.

The reconstruction of the plant, as outlined above, was carried

FIG. 1.—TRANSMISSION LINE CROSSING RICHELIEU RIVER.

out in accordance with the designs and under the supervision of Mr. Ralph D. Mershon, consulting engineer for the Power Company, with the exception of the receiving station building, in connection with the design of which Mr. Mershon acted in an advisory capacity. The induction motor generator plant in the power house of the Montreal Street Railway Company was also installed under the designs and supervision of Mr. Mershon as consulting engineer for the railway company.

Energy delivered by the Chambly water power plant at about 25,000 volts is received in the central sub-station, on Queen Street, at 22,000 volts, through underground cables. There are four of these cables, corresponding to the four three-phase circuits that come from the Chambly plant, and each cable contains three stranded copper conductors of 211,600 circ. mils cross section each. Paper saturated with compound is the only insulation in these cables, and outside of the paper is a lead sheath about 5/32 in. thick. The side of each conductor is about 7/16 in. distant from the lead sheath at the nearest point, and the distances between the conductors themselves are about 11/16 in. in each case. The lead sheath of the cables contains about 3 per cent. of tin. Inside of the sheath the diameter of the paper insulation is about 2¾ in., and outside the lead has a diameter of 3 1/16 in.

Each of the four cables is about 3,600 ft. long, and extends from the central sub-station to a terminal house on Mill Street, which lies between the Lachine Canal and the river front not far from the Montreal end of the great Victoria Bridge. For the greater part of their length the cables lie in 4-in. Camp tile ducts, but where they go under the Lachine they lie in 4-in. iron pipes. At the terminal house the cables connect with the bare overhead conductors that run to Chambly by way of the Victoria Bridge.

The terminal house on Mill Street is a one-story structure 21 by 34 ft. outside, and with concrete walls 8 in. thick. An internal wall of concrete divides the interior of this house into two equal parts, and two of the four three-phase circuits enter each half. A wooden cross arm is secured with its center 22 in. from the outside of the wall at each end of the building by iron brackets, and with its top 16 ft. 10 in. above the ground. Each of these cross arms carries six porcelain insulators mounted with their centers 30 in. apart, and to each of these insulators a bare conductor of one of the transmission circuits is attached. Somewhat above these insulators and with their outer ends slanting downward boxwood bushings, each 4 in. x 4 in. x 12 in., pass through the concrete wall, one bushing opposite each insulator.

Each of these bushings carries a glass tube, and through this tube the bare wire from the nearest insulator passes. Inside of the terminal house the bare conductors pass to other porcelain insulators mounted on cross arms, and each conductor is connected to a series of lightning arresters before it joins the cable. Above each cross arm on the outside walls of the terminal house a slanting weather shield is built. By means of the 8-in. concrete wall inside of the terminal house the pair of circuits that enter on one side is protected from damage by any short-circuit that may occur on the pair of circuits at the other side.

After leaving the terminal house the twelve bare conductors that make up the four three-phase circuits pass over a short pole line to the Victoria Bridge. This is one of the few instances if not the only one, where bare conductors carrying current at as much as 22,000 volts are brought on poles within the limits of a great city.

At the bridge the bare conductors are carried on heavy timber fixtures entirely over the top of the trusses. Each of the twelve conductors that make up the four transmission circuits is a solid, medium-drawn copper wire, No. 00 B. & S. gauge. These circuits are carried on two pole lines, there being two circuits per pole. Each three-phase circuit is arranged on two cross arms and on one side of its pole. On the lower of these two arms two wires of the same circuit are spaced 30 in. apart, and the third wire of this circuit is located on the upper cross arm at a distance of 28 in. from each of the other two. The transmission line between the terminal house on Mill Street and the power station at Chambly is 16 miles long. Over the Victoria Bridge one circuit of each pole line is transposed three times, and the other nine times to nullify the effect of the iron. Between the bridge and the power plant each of two circuits is twice transposed; hence this part of two circuits, one of either pole line, is

FIG. 2.—CHAMBLY TRANSMISSION LINE TOWERS.

divided into three sections of equal lengths. Each transposition is effected between two poles placed 10 ft. apart, each wire of a circuit being rotated through 120° between these poles. This transposition is carried out to overcome the effects of mutual induction, and as a protection to telephone and telegraph lines. The standard distance of the lowest wires in these circuits above the ground is 32.5 ft., and the regular length of span is 90 ft. Between the angle poles on the line the normal length of span is reduced to 50 or 75 ft., and such poles have double cross arms if the deflection of the conductors is more than 15°. The two pole lines, each carrying two three-phase circuits, are located 50 ft. apart on either side of the right of way.

No lightning arresters are connected to these transmission lines save at the terminal house and at the generating station. Along the

entire line three grounded wires are strung on each set of poles as a protection against lightning. As may be noted from the above, the upper cross arm on each pole carries only two power wires, one belonging to each transmission circuit. Near each end of this cross arm and 32 in. from the power wire on that side, a barbed wire is mounted on a pony glass insulator. This barbed wire is made up

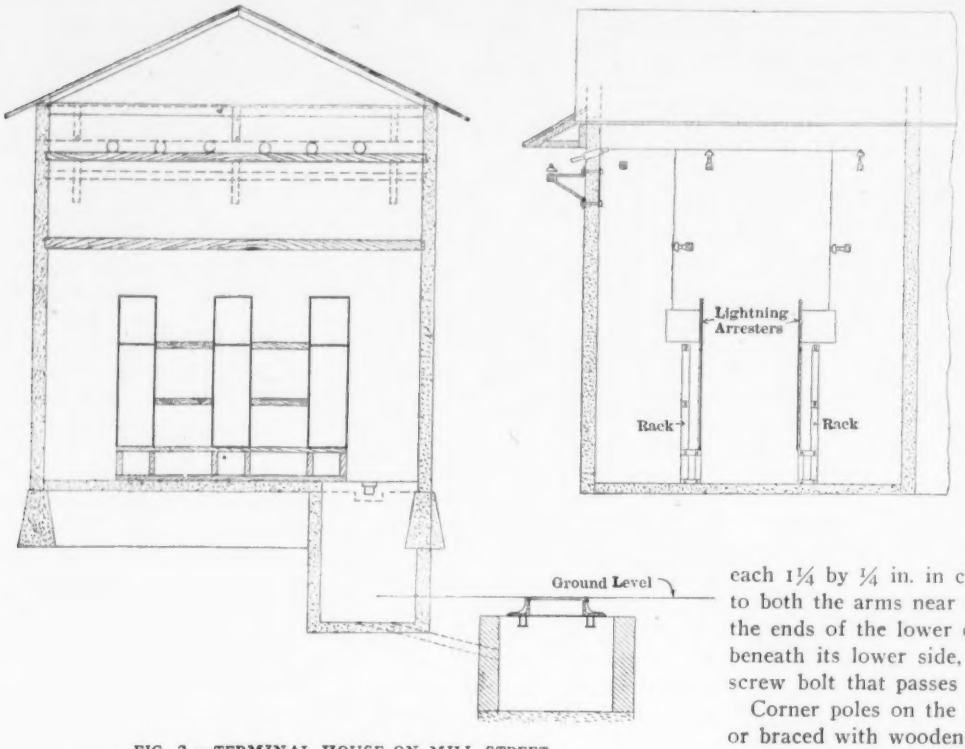


FIG. 3.—TERMINAL HOUSE ON MILL STREET.

of two No. 12 B. W. G. galvanized iron wires twisted with a four-point barb every 5 in. Another barbed wire is strung on pins in the pole tops. At each pole a ground wire is soldered to each of the barbed wires, and this wire is stapled down the side of the pole and twisted several times about its butt before the pole is set in the ground. Insulators are used to mount the barbed wire, because of the superior mechanical support thus obtained, but with no desire to insulate it in any way. No damage by lightning has ever been done to these transmission lines having the barbed wires, while shorter distribution circuits in the same locality have suffered severely from the frequent thunder storms that occur there. For this reason the grounded barbed wires are thought to afford a high degree of protection.

On the same poles that carry the transmission circuits two No. 12 hard-drawn copper wires are run for telephone purposes. These telephone wires are attached to the poles by side brackets and pony glass insulators, and spun or barrelled throughout. The telephone wires are 6.25 ft. distant from the nearest wires of the transmission circuits. Stations with jack boxes are located at intervals on the poles for the use of line inspectors, and telephones are connected to the two wires in multiple. For the protection of both users and telephones the latter are provided with film cutouts. Between the telephone wires and the ground there is an induced pressure of 125 volts. In case either of the telephone wires is broken or they are short-circuited, signals are transmitted according to a prearranged code by means of small incandescent lamps, using a telegraph key, the ground and one of the telephone wires to make a circuit.

All of the insulators that support the bare copper conductors of the four three-phase circuits are of white porcelain and were made by R. Thomas & Sons, East Liverpool, Ohio, under the trade designation of 6-in. Boch T. P. and Mershon type. Porcelain insulators were selected rather than glass because of their greater strength. Each of the 6-in. Boch insulators is 5½ in. in diameter, and when it is mounted on its pin the lower edge of the outside petticoat is 4½ in. above the top of the cross arm. A sleeve from the interior of each insulator follows its pin down for a distance of 2½ in. below the edge of its outside petticoat. Each wire is carried on the top of its insulator and is then 8½ in. above the cross arm.

Conductors nearest to the pole are distant about 10 in. from its side, and neither of the conductors is nearer than 18 in. to the iron braces of the cross arms. From conductors mounted on insulators of the lower cross arm to the lower side of upper cross arm the distance is about 9 in. These insulators were tested at the factory with a pressure of 80,000 volts while immersed in salt water.

Pins for the insulators on which the transmission wires are mounted are made of hickory wood boiled in stearin and the part entering the cross arm has a diameter of 1½ in. Each pin is secured in the arm by a 2½-in. wire nail driven into both. Each cross arm for the three-phase circuits measures 11 ft. by 5 by 4 in., and is made of Georgia pine boiled in liquid asphalt. Gains for the cross arms were cut 1 in. deep in poles, and each cross arm was secured with three ½-in. lag screws. The two cross arms on each pole have their centers 23 in. apart and are braced by four pieces of strap iron each 1¼ by ¼ in. in cross section. One piece of this iron is bolted to both the arms near each end, and the other two pieces pass from the ends of the lower cross arm to a point on the pole 4 ft. 5½ in. beneath its lower side, and are secured at that point by a common screw bolt that passes into the pole.

Corner poles on the transmission line are guyed with steel cable, or braced with wooden struts, or both, and guys where used are attached 18 in. below the lower cross arm. Each of these guys is provided with a strain insulator. Most of the poles used on the transmission lines were round cedar, but a few were steel. Cedar poles of all lengths were required to be of not less than 8 in. diameter at the top, and 18 in. at the butt. The butts of these poles were tarred and the tops were rounded to shed water. Poles were set

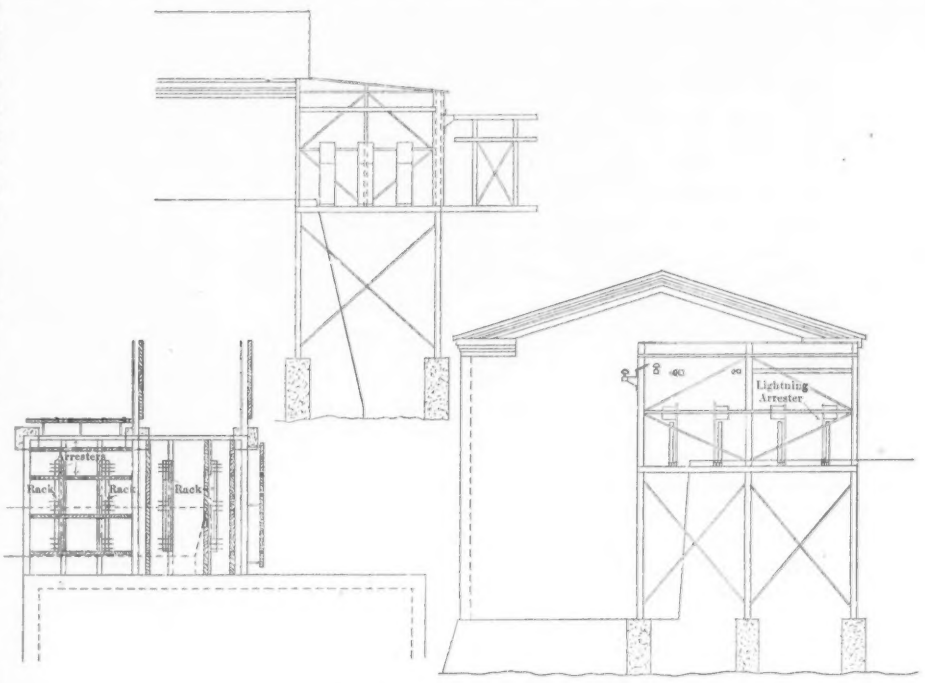


FIG. 4.—TERMINAL HOUSE AT CHAMBLY.

in earth as follows: Poles 35 to 45 ft. long, set in earth 5 ft.; 50 to 55 ft. long, set in earth 6 ft.; 60 to 80 ft. long, set in earth 7 ft. Where the ground is marshy the butts of poles are set in concrete for greater stiffness.

A short distance down stream from the power station at Chambly the two pole lines with their four three-phase circuits cross the Richelieu River. For this crossing six spans were employed, and six

concrete piers were erected in the river to support the poles, two poles being set in each pier. Each pole at this crossing is provided with double cross arms, so that each of the twelve 2/0 copper wires has two points of attachment at each pole. The length of each of the spans across the river is about 125 ft. Not far from the river crossing just named the transmission circuits cross the Chambly Canal through which boats pass between Lake Champlain and the St. Lawrence River.

The length of span over this canal is about 132 ft., and with a sag of 5 ft. in the wires that make the span their height above the water in the canal is not less than 131 ft. For the purpose of carrying the circuits over this canal four steel towers were erected, two towers being used for the circuits on each of the two lines of poles. In view of the recent talk about the substitution of steel towers for wooden poles, to carry transmission lines, the details as to the size, weight and cost of the towers in this case may be of especial interest. Each pair of towers was designed to carry twelve No. 2/0 bare copper wires whose diameters had been increased to 1 in. by ice, and to resist all wind pressures without a strain in any member of more than one-fourth of its ultimate strength. The vertical height of each tower is 144 ft. above the foundation. At the top each tower measures 16½ by 16½ in., exclusive of cross pieces that receive the cross arms. Not less than 121,000 pounds of steel was used in the four towers, and their contract price erected on foundations furnished by the purchaser was $5,670, in January, 1902.

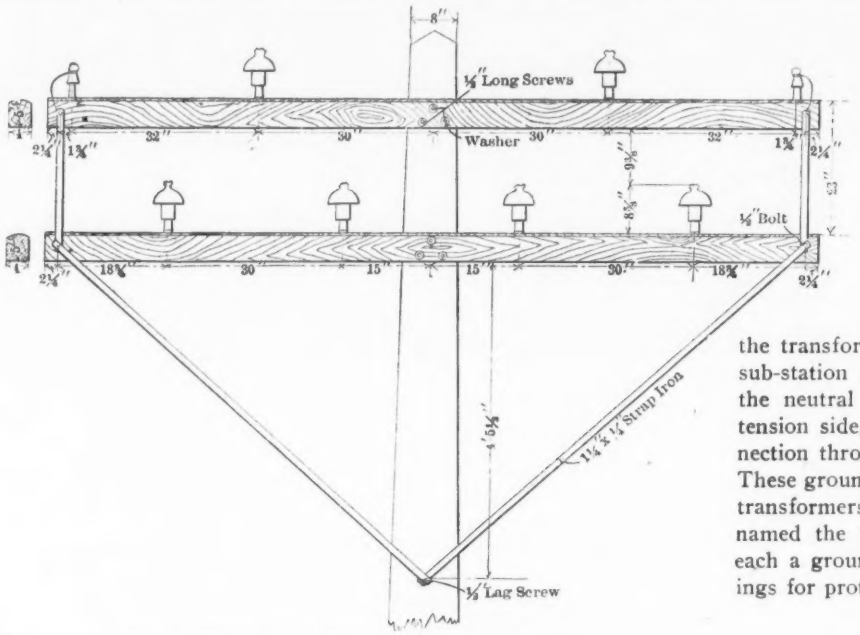


FIG. 5.—POLE WITH CROSS ARMS IN POSITION.

Each tower is provided with a ladder, and supports three sets of cross arms, each set consisting of four cross arms in one horizontal plain. One set of cross arms rests on the top of the tower, the center of the middle set is 30 in. below that of the highest, and the center of the lowest set is 30 in. below that of the second. Two cross arms of each horizontal set are on one side of the tower, and the other two arms of that set are on the other side. Each of the wooden cross arms on the towers is 13 ft. long, and the width across the four arms that make up a set is 4 ft. ½ in. Each set of cross arms provides four insulators for the support of each wire passing over them. Before entering the terminal house at the river end of the power station at Chambly, the four transmission circuits are attached to insulators carried by a heavy timber frame just outside. This frame carries four insulators for each conductor.

The terminal house itself is a one-story structure of steel and concrete, and is separated from the main power house by the end wall. In plan the terminal house is about 18 by 29 ft., and it rests on a steel framework that puts its first floor about 20 ft. above the foundation. The steel I beams on which the terminal house rests extend out about 12 ft. beyond its river side in order to support the timber framework to which the transmission lines are attached.

After leaving an insulator on a cross arm 22 in. from the outside of the concrete wall of the terminal house, each bare conductor passes through a glass tube surrounded by a wooden bushing in that wall. Each of these bushings is of oak 4 in. in diameter, 12 in. long and was boiled in stearin. A little distance inside of this wall each bare 2/0 wire is dead-ended on an insulator like those outside, and an insulated cable is here connected and runs thence to the step-up transformers in the power station. Near the juncture of the bare conductor and the insulated cable a wire is connected that runs to a series of 38 lightning arresters of the brass cylinder and air-gap type, each arrester having six gaps. Between the point where the series of 38 lightning arresters is connected to one of the transmission wires, and the point where this wire is connected to its transformer three inductance coils are inserted in series with each other. Each of these coils is flat, contains 14 turns and is one turn wide.

In each series of lightning arresters the twelve arresters nearest the earth are in shunt with a German silver resistance, and another resistance in series with all of the lightning arresters of each series completes its connection to earth through a copper plate 4 x 6 ft. by ⅛ in. in running water. Knife switches are provided in the 25,000-volt lines at the terminal house, and all of these lines are connected to static ground detectors. From the lightning arresters and knife switches the four three-phase circuits pass directly to the step-up transformers in the main part of the station. These transformers are connected Scott fashion in pairs, each pair receiving two-phase current at 2,200 volts, and delivering three-phase current at 25,000 volts. There are ten of these transformers, each rated at 2,750 kw, so that their combined capacity is 27,500 kw. These transformers are of the air-blast type and Westinghouse make. Both

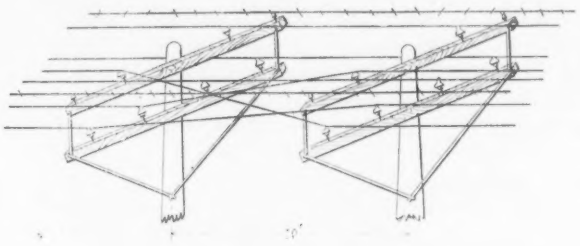


FIG. 6.—TRANSPOSITION POLES.

the transformers at Chambly water power plant and at the central sub-station in Montreal are Scott-connected. At the power plant the neutral connection of transformers is grounded on the high-tension side, and at the central sub-station there is a ground connection through a spark-gap to the neutral on the low-tension side. These ground connections are made for the purpose of protecting the transformers from lightning discharges. At the sub-station just named the transformers, which are of Westinghouse make, have each a grounded shield between their primary and secondary windings for protection to the secondary.

A Great Electric Thoroughfare.

One of the notable additions to the New York City landscape is the big Williamsburg Bridge, across the East River, which is being opened this week with civic celebration, fireworks and electric light displays. The opening of the bridge will be welcomed by all who have to cross the East River daily, especially during the rush hours, as it will greatly relieve Brooklyn Bridge. The new bridge connects with a large and important manufacturing district, and the arrangements for transportation lines are on a much larger scale than could ever be provided by the old Brooklyn Bridge. It is 118 ft. in width, as compared with 85 ft., the width of the Brooklyn Bridge. It also has two decks instead of one, two foot walks, each 10½ ft. in width, two bicycle paths, each 7 ft. wide, four trolley tracks, two elevated railway tracks and two roadways, each 20 ft. in width. The old bridge has one promenade 15 ft. wide, two roadways, each 18 ft. wide, and each giving half of its space to the trolley tracks, and two elevated railway lines.

The trolley lines on the new bridge will greatly increase present facilities, as there will be four tracks running in a space especially devoted to their use, thus providing facilities for operating 350 cars an hour, and handling 70,000 persons traveling in both directions, as against 40,000 an hour on the Brooklyn Bridge. Trolley cars will also be free from trucks, wagons or carriages, and the elevated railroad will provide for the carrying of at least 29,000 persons in one direction every hour, or 58,000 persons going and coming across the bridge, thus raising the maximum to 128,000 an hour. This the bridge, thus raising the maximum to 128,000 an hour.

Conductivity of Mercury Vapor.

BY PETER COOPER HEWITT.

THE electrical conductivity of gases and vapors and its relation to the conditions under which the electrical current is maintained has occupied my attention for many years. A large number of experimental data accumulated during the progress of my work, which when properly arranged and co-ordinated, furnish a theory of electrical conduction through gases which seems to account satisfactorily for the phenomena observed. It was thought desirable to perform additional experiments for the purpose of obtaining exact quantitative measurements upon some particular gas and for this purpose mercury vapor was selected. The results of these experiments are given in the following brief summary. I was fortunate to secure, during the progress of this work, the assistance of Dr. A. P. Wills, who expects to publish in the near future a detailed account of the methods and apparatus employed in this experimental study.

A gas or vapor forming part of an electric circuit exhibits three distinct sources of electrical reactions, namely, one at the junction of the positive electrode of the conductor with the gas or vapor, one in the gas or vapor uninfluenced by the electrode effects, and one at the junction of the gas or vapor with the negative electrode.

Difficulty was experienced in obtaining electrical measurements upon the conducting gas or vapor independent of these electrode effects; the measuring instruments require the use of terminals or electrodes in contact with the gas or vapor with the electrode resistances accompanying them; difficulty was also met with in obtaining the gas or vapor in a state of purity. The results given in the diagrams are not vitiated by terminal or electrode effects. The measurements were taken in such a way as to be subject to but little variation from the effects of the current during the time of observation.

Fig. 1 is a diagrammatic view of the apparatus. Two upright chambers of insulating material were connected together at the top and bottom, thus forming one continuous air chamber. One chamber contained an electric heating coil, the current supply of which could be regulated externally; a centrifugal fan over this chamber produced a rapid circulation of the air contained by the two chambers

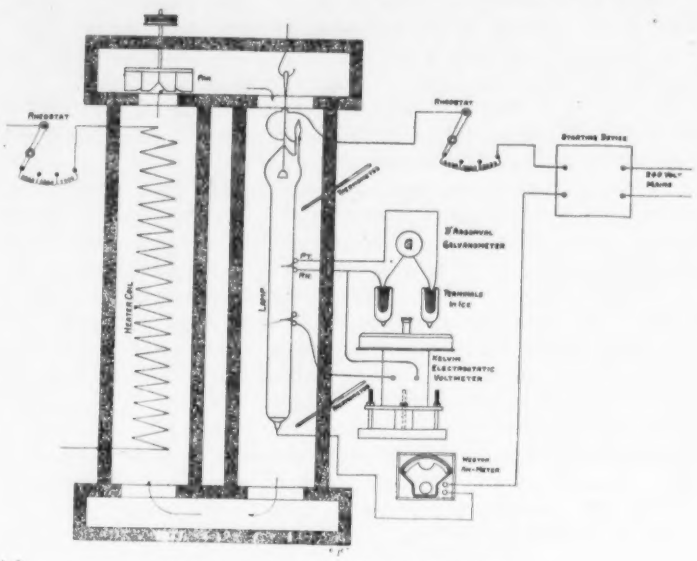
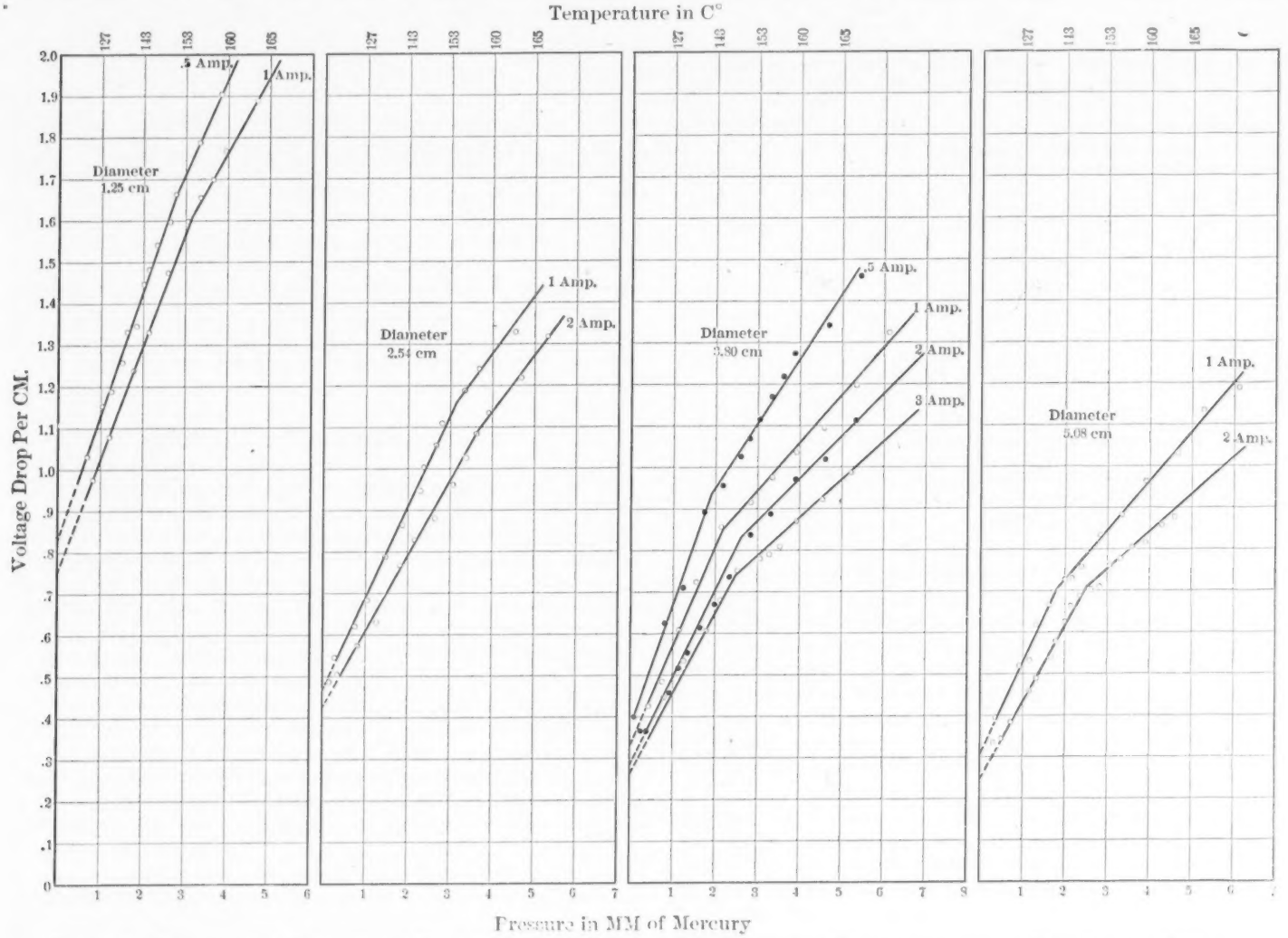


DIAGRAM OF MEASURING APPARATUS.

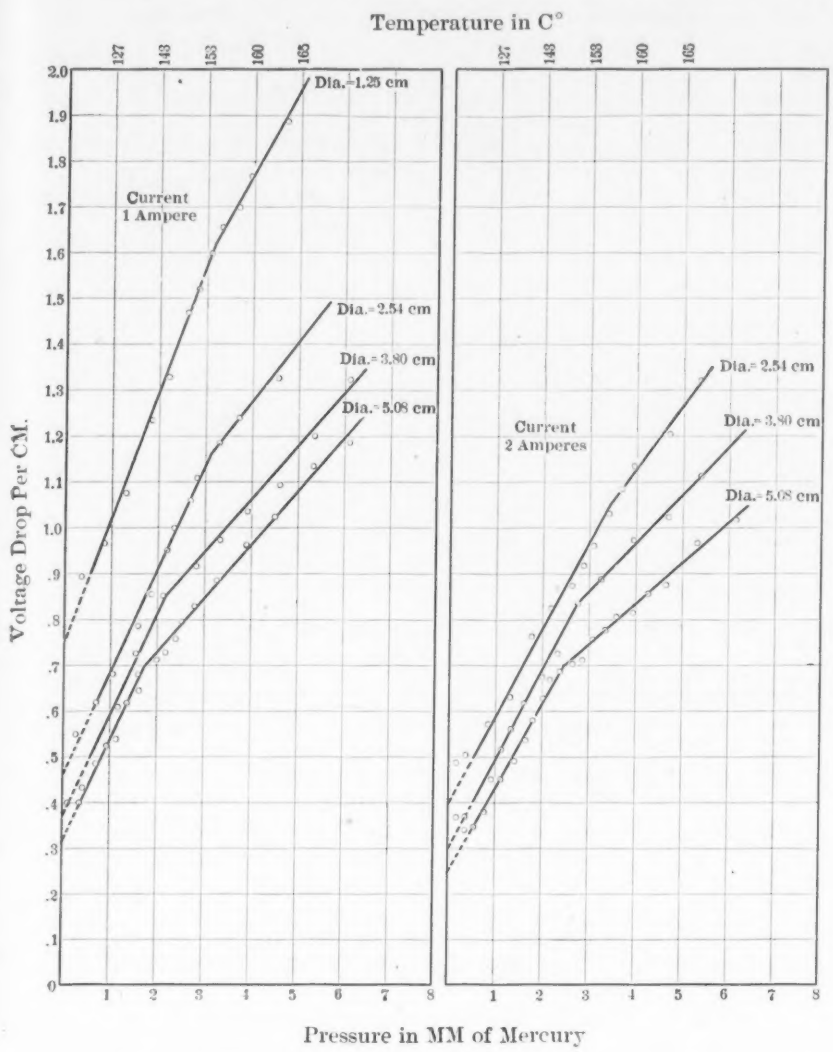
for the purpose of bringing the whole to a uniform temperature, which was regulated by the heating coil. In the other chamber was placed the vessel containing the gas or vapor, marked "lamp" with the necessary electric connections. Thermometers were inserted at both ends, as shown, for determining the external temperature. Two platinum-rhodium couples were sealed in the walls of the lamp at a measured distance apart, and extended to the center. The external terminals of the couples were immersed in ice and connected to a



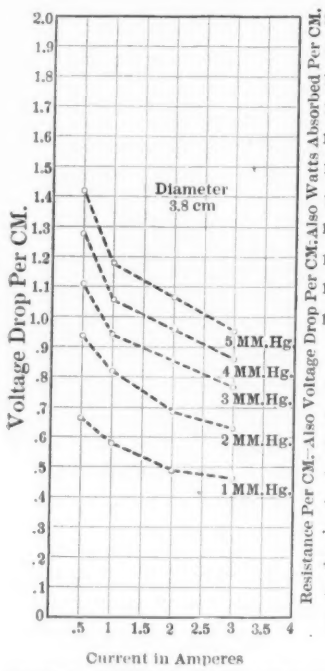
DIAGRAMS SHOWING THE RELATION OF DROP IN VOLTS PER CM. OF LENGTH TO THE PRESSURE IN MM. OF MERCURY FOR DIFFERENT CURRENTS IN LAMPS OF GIVEN DIAMETER.

D'Arsonval galvanometer. The internal temperature was measured by means of these couples by observing the deflection of the galvanometer. It was possible to ascertain accurately when the internal and the external temperatures were the same. The drop in volts between the platinum-rhodium points was taken by a Kelvin electrostatic voltmeter; the couples thus served a double purpose. It was possible to obtain voltage measurements at the temperatures desired. When a required temperature was obtained internally and externally, the current was started through the lamp by the starting device, and was controlled by an external resistance and measured by a Weston ammeter. Immediately after starting the current, the reading of the Kelvin voltmeter was taken. There was sufficient time to obtain these readings accurately before the current materially altered the vapor density.

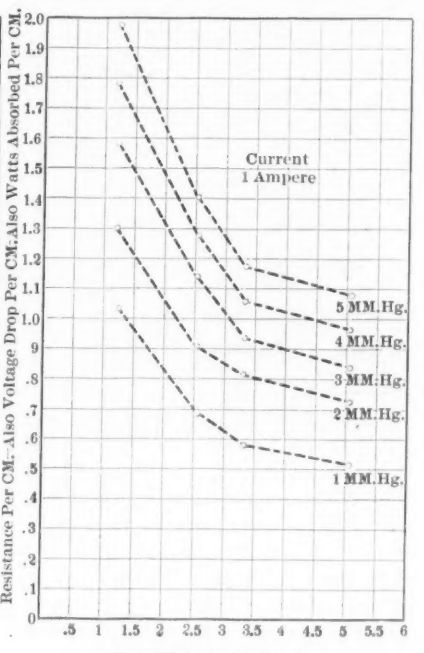
The lamps contained some mercury and were exhausted with great care until nothing but mercury and its vapor were present. The size



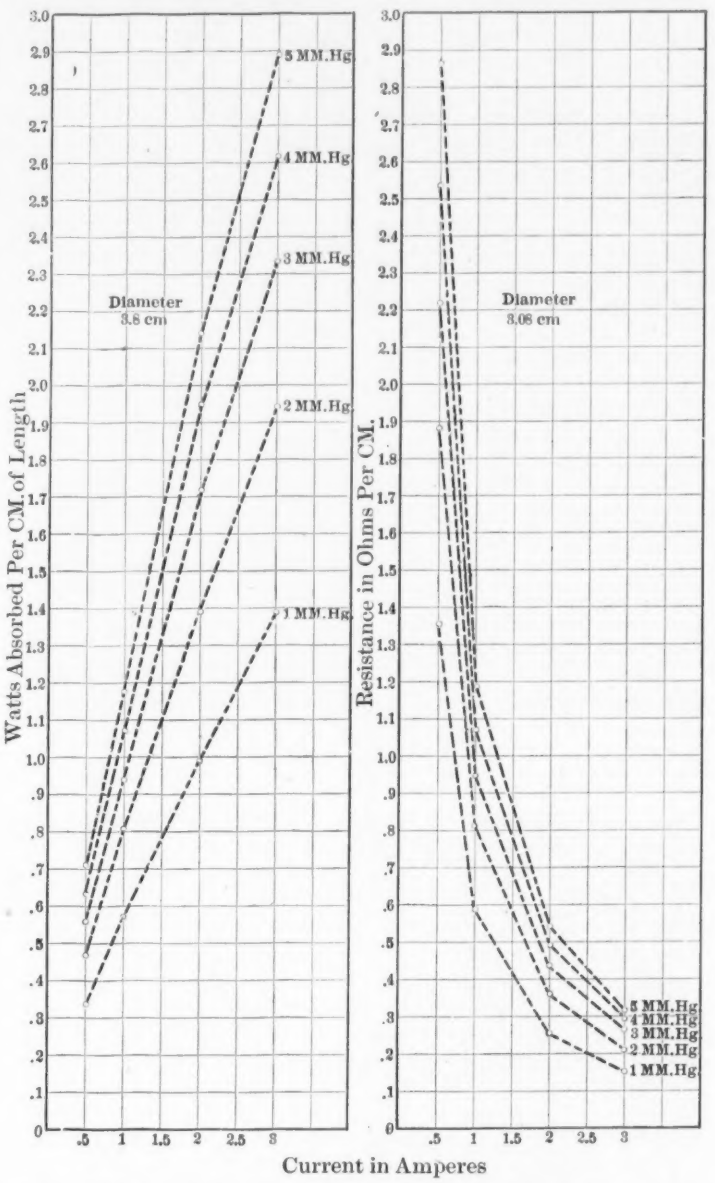
DIAGRAMS SHOWING THE RELATION OF DROP IN VOLTS PER CM. OF LENGTH TO THE PRESSURE IN MM. OF MERCURY FOR LAMPS OF DIFFERENT DIAMETERS AT CONSTANT CURRENT.



DERIVED CURVES SHOWING THE RELATION BETWEEN VOLTAGE DROP PER CM. TO THE CURRENT IN AMPERES FOR DIFFERENT PRESSURES OF MERCURY VAPOR.



DERIVED CURVES SHOWING THE RELATION OF RESISTANCES PER CM.; VOLTAGE DROP PER CM.; AND WATTS ABSORBED PER CM. TO THE DIAMETER OF TUBE IN CM. FOR DIFFERENT PRESSURES OF MERCURY VAPOR.



DERIVED CURVES SHOWING THE RELATION BETWEEN WATTS ABSORBED PER CM. OF LENGTH TO CURRENT IN AMPERES FOR DIFFERENT PRESSURES OF MERCURY VAPOR.

DERIVED CURVES SHOWING THE RELATION OF CURRENT IN AMPERES TO THE RESISTANCE IN OHMS PER CM. OF LENGTH FOR DIFFERENT PRESSURES OF MERCURY VAPOR.

of the tube used for the lamp limited the diameter of the conducting vapor column, and its diameter is the diameter given in the diagram.

The relation of the pressure of the saturated vapor to the temperature was deducted from the observations of Ramsay and Young: the density is proportional to the pressure. The walls of the lamp being covered by small globules of mercury and a large amount of mercury being present at the bottom of the lamp, the vapor was considered to be in a state of saturation.

The points on the curves indicate actual readings; the drop in volts and temperature were observed. In most cases the experiments were repeated many times with different lamps, and with the same lamp re-exhausted, in order to be certain that only mercury vapor was present in the lamp, since the presence of a small amount of another gas will cause considerable variation in the measurements. For

instance, on admitting a different gas into a lamp containing a pure gas, the effect may be observed by the measuring instruments.

The diagrams show the influence of density, diameter and current on the drop in volts per unit length. From them can be deduced the resistance, as a function of the density current and diameter.

They show that the voltage required to maintain an electric current in a gas or vapor is directly proportional to the density, and that it decreases as the diameter of the lamp increases. The resistance decreases with increase of current. From the diagrams, relations among the diameter, density and current may be established.

The current assumes a definite cross-section for a given density and current when not restricted by the lamp; this cross-section increases with increase of current and decreases with increase of density. The angles in the curves shown may be due to these effects, but this point needs further investigation.

The light efficiency of mercury vapor varies with the density; there is a density of maximum light efficiency. On passing a current at a very low density practically no light is visible and the drop in volts for the same current is less than at greater densities. At densities greater than a certain limit the light efficiency decreases. If another gas is present with mercury vapor, the current is usually selective and gives the spectrum of mercury vapor, but the resistance is materially altered. The effect of magnetic force transversely applied at low densities is very marked, and is that of increasing the resistance in an extraordinary degree, while at higher densities it increases the resistance but little. Magnetic force alters the spectrum particularly at low densities.

The experimental curves speak for themselves; the conclusions which may be drawn with respect to the relation of the conductivity of mercury vapor to the physical conditions under which the electrical current through the vapor is maintained appear to be, broadly speaking, generally true for all gases and vapors. It is not necessary to enumerate here all these conclusions, for they are sufficiently evident on the face of the curves. Some curves are given which have been deduced from the curves obtained by direct experiment. They are marked in the diagrams as "derived" curves. There is one conclusion, however, which from a purely technical point of view deserves special attention. It is this:

When a given vessel containing mercury vapor is to be employed as a source of light, that is, as an electric lamp, the highest light efficiency will be obtained when the vapor density and the current employed have a definite and fixed relation.

German Gas Engine Power Stations.

By Frank C. Perkins.

A LARGE number of electric power plants have recently been designed and constructed in Germany, in which gas engines of various sizes have been utilized exclusively for driving the electrical generators. The types of engines used in these installations may be divided into four classes. First, those having single cylinders of the single-acting type working on the Otto cycle, a plant of this character being noted in the accompanying illustration, Fig. 3. Second, those employing cylinders on opposite sides of the fly-wheel and electrical generator, as shown in the accompanying diagrams and Figs. 1 and 2, and in Fig. 4. Third, central stations utilizing twin gas engines of the single-acting type, consisting essentially of two single-cylinder Otto cycle gas engines, one being directly-connected to the armature shaft on either side of the electrical generators, as seen in Fig. 5. Fourth, double-acting engines are employed in the various ways above mentioned and also with two cylinders connected in tandem.

The double-acting Deutz engine noted in Fig. 6 was constructed for driving a direct-current electrical generator at the plant of the Actien-Gesellschaft-Lauchhammer, and has a capacity of 300 hp. The gas engines and direct-current generators installed at the Elektricitätswerk at Münster, i. W., Germany, as illustrated in Fig. 5, include four units each having a capacity of 200 hp. The engines were constructed at Köln-Deutz by the Gasmotoren Fabrik Deutz. This engine room is one of the most handsomely decorated of any in Germany. The switchboard gallery is located directly over the main entrance and is very artistic in appearance. The electrical equipment, including the direct-current dynamos, which are of the fly-wheel type, as well as the switchboard apparatus, were installed by the Elektricitäts-Actien-Gesellschaft, formerly W. Lahmeyer & Co., of Frankfort-on-the-Main, Germany. These generators each have a capacity of 160 kw and operate at a speed of 170 r.p.m. They each generate a current of 320 amp. at 500 volts.

At the Hoerder Bergwerks und Hütten Verein in Germany, the electric power station, as shown in Fig. 4, is operated by two gas engines, each having a capacity of 1,000 hp. These engines are operated by waste blast furnace gases and drives a large three-phase generator at the speed of 135 r.p.m. Each engine weighs about 176 tons.

In these engines, which were also constructed by the Gasmotoren Fabrik Deutz, the fly-wheel effect is produced by the revolving field of the alternator. The dynamos have each a capacity of 810 kw and supply a polyphase current of 270 amp., the potential being 3,000 volts. The generators were constructed by the Elektricitäts Actien Gesellschaft, formerly Schuckert & Co., of Nüremberg, Germany,

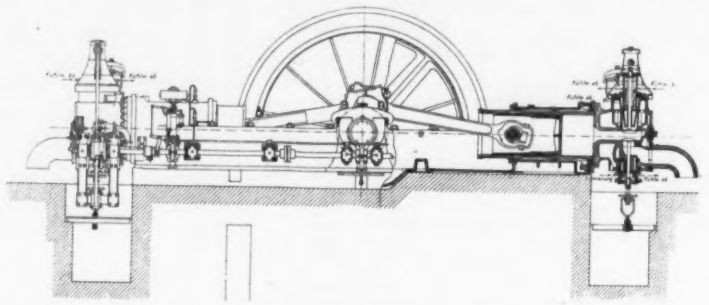


FIG. 1.—ELEVATION OF 500-HP DOUBLE-CYLINDER DEUTZ GAS ENGINE.

and the power developed by the waste blast furnace gases is utilized for operating electric motors about the works as well as for supplying current for both arc and incandescent lamps about the great plant.

The Hoerder Bergwerks und Hütten Verein was changed to a limited liability company in 1852 with a capital of six million marks. The works consist of the blast furnace plants in Hoerde and Dortmund, the Hermann's mills, foundries and smelting works in Hoerde, and the collieries at Hoerde, including the Pit Scheswig, near Brackel, and Pit Holstein, near Asseln.

The Hoerde Verein was a pioneer in the utilization of waste gases by internal combustion motors. The first successful trial was undertaken in 1895, but the first large engine which was set at work continuously after long difficulties was in 1898. At present the electric power station is fitted with three Oechelhaus gas engines of 600 hp

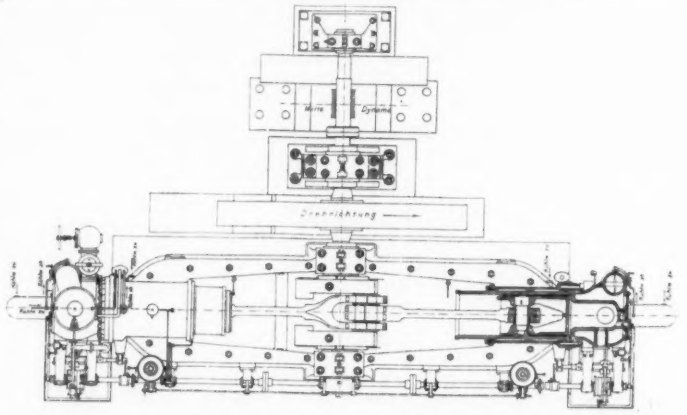


FIG. 2.—PLAN OF 500-HP DOUBLE-CYLINDER DEUTZ GAS ENGINE.

each, and two of 1,000 hp-capacity each, constructed by the Gasmotoren Fabrik in Deutz, as mentioned above. This plant gives excellent satisfaction and the electrical energy is used for various purposes at the Hermann Works and in the collieries.

The electric power station at Friedenshütte, near Morganroth, is equipped with high-power gas engines of the Otto cycle type, using waste blast furnace gases for fuel from the works of Oberschles Eisenbahn Bedarfs Actien-Gesellschaft. There are four units in this plant with a total capacity of 1,000 hp. Two of the engines operated at a speed of 150 r.p.m. and have a capacity of 200 hp each, while the remaining two units are somewhat larger, developing 300 hp each, with a normal speed of 167 r.p.m. The fly-wheels of the smaller engines weigh 9 tons each and measure 10 ft. in diameter, while the larger fly-wheels weigh 20 tons each and have a diameter of 15 ft.

The electrical generators are of the multipolar direct-connected three-phase type, constructed at Nüremberg, Germany, by the Elek-

tricitäts Actien Gesellschaft, formerly Schuckert & Co. Two of the alternators are 132-kw machines each, supplying a current of 600 amp. at 2 × 110 volts on the three-wire system. The remaining alternators each have a capacity of 250 kw and generate a current of 500

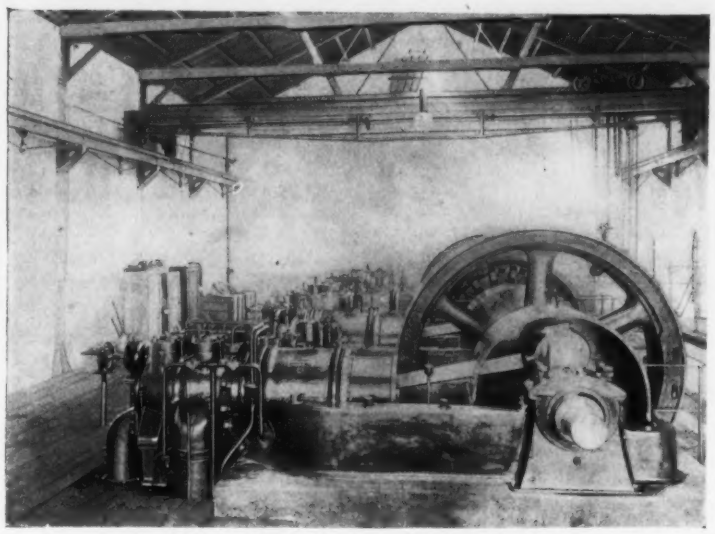


FIG. 3.—POWER STATION AT FRIEDENSHUETTE.

amp. at a pressure of 500 volts. This plant is illustrated in Fig. 3, and Figs. 1 and 2 are drawings of a 500-hp, double-cylinder Deutz gas engine, direct-connected to an electrical generator.

This type of engine has a very heavy fly-wheel to aid in the regulation, as the two impulses are delivered in one revolution and no impulses are given in the next revolution. The two cylinders are controlled independently and there are, therefore, a large number of air, gas, exhaust and water-cooling pipes, which are, however, compactly arranged and are not at all cumbersome.

With the single-acting Deutz gas engine the gas valve and the inlet valve are combined with a piston valve mounted on the same spindle, the air being admitted into the same casing. As the valve spindle is pressed down by the gear mechanism, the inlet is opened first and the air valve and the gas valve follow a moment later, opening inward or downward. A powerful spring supplies the necessary pressure to close the parts upward. The spindle of the valve is attached to one

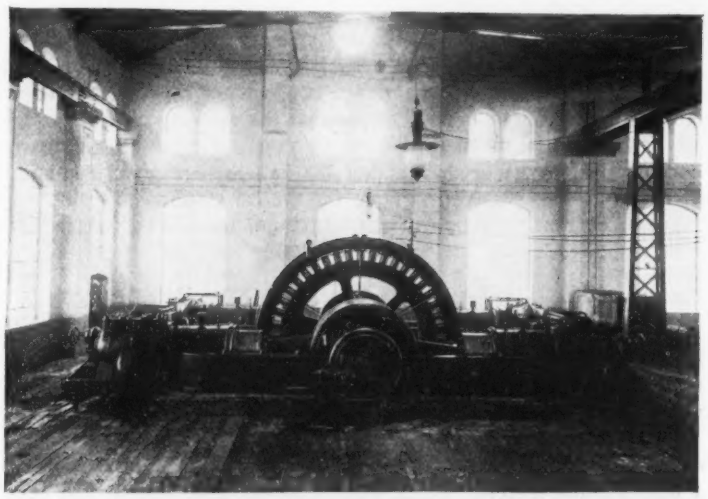


FIG. 4.—POWER PLANT AT HOERDER, GERMANY.

end of the valve lever and the other end to a rod driven from the valve shaft, a roller supporting the valve lever.

The valve lever presses against the roller when the driving rod is lifted, the inlet valve is forced downward and the valve is then closed as the driving rod descends. This valve closes toward the end of the suction stroke and opens at the beginning of the stroke.

It will be observed from the drawings, Figs. 1 and 2, that the two cylinders, one on each side of the central shaft, are duplicates, the valve mechanism being also the same. When the position of the roller is changed by the governor the valve is opened more or less, but for the same length of time. By throttling the gas and air mixture the proper regulation is obtained. This is accomplished by changing the sizes of the openings for the air and gas at the same time, the mixture remaining practically the same, but a larger or a smaller amount of the mixture entering the cylinder, according to the position of the governor. The compression is also changed by

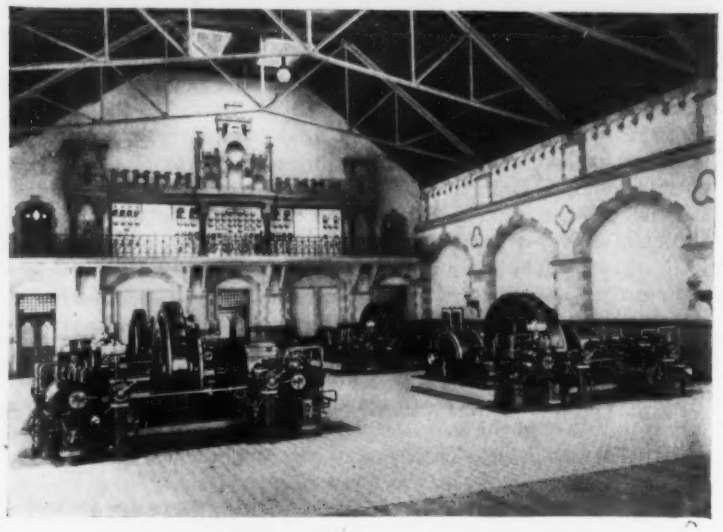


FIG. 5.—INTERIOR VIEW OF MÜNSTER STATION.

this regulation, but it is stated that the engines work exceedingly well under light loads.

Double-acting gas engines of large sizes are now being constructed by a number of prominent engineering firms abroad, such as the Koerting and Cockerill, the former being a double-acting, two-cycle engine and the latter being of the double-acting four-cycle type. A Deutz double-acting four-cycle engine has recently been designed, having at each end of the cylinder an inlet valve combined on one spindle with a gas and air valve, while the exhaust valve is placed very low. It is said to work very regularly and economically and is much smaller than the single-acting engines of the same capacity. The double-acting, four-cycle engines are, however, larger than the double-acting, two-cycle types of the same capacity.

High-power gas engines have proven of great service in making use of waste blast furnace gas, which is capable of supplying 1,000

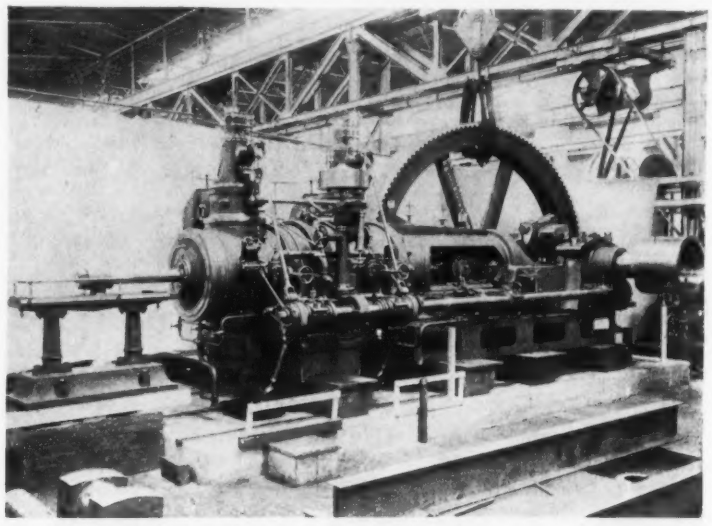


FIG. 6.—300-HP DOUBLE-ACTING DEUTZ GAS ENGINE AT LAUCHHAMMER.

hp, it is claimed, for every 100 tons of pig iron produced. Gas engines are now in operation driving electrical and generators as well as blowing engines, with capacities ranging up to 1,000 hp for single-cylinder engines and from 1,200 to 2,000 hp with double tandem cylinders, while double-acting engines have been designed of 5,000 hp for driving electrical generators, two 2,500-hp engines being directly-connected to the same alternating-current machine.

There is every reason to believe that during the next decade thousands of horse-power will be generated by waste blast furnace gases in the power houses of iron and steel plants in this country, as is now being done in the largest power plants abroad.

Physical Equipment of American Central Stations.

IN continuance of our digest and analysis of the statistics of central stations in the United States, as reported by the Census Office, we will now take up the data of physical equipment of the 3,620 plants reported upon. It appears that more than one-half of the private stations and three-fourths of those operated under municipal control have a dynamo capacity of less than 200 hp. The dynamo capacity of 86.3 per cent. of all central electric stations is less than 500 hp, and 83.8 per cent. of the stations operated under private ownership have a dynamo capacity of less than 500 hp each, as compared with 95.2 per cent. of the stations operated under municipal control. Of the total number of private stations, 7.1 per cent. have a dynamo capacity of between 500 and 1,000 hp, while 3.1 per cent. of the municipal stations are included in this group. The dynamos of only 1.7 per cent. of the municipal stations have a horse-power capacity exceeding 1,000, while the horse-power capacity of 9.1 per cent. of the private stations exceeds this quantity.

In 3,301 stations, the dynamos are operated by the use of steam or steam and water power. In a number of cases the steam power is merely auxiliary to the water power, being used only when the water power is not available. There are 319 stations in which the machines are operated by the use of water power exclusively. These stations have 649 water wheels with a stated capacity of 222,585 hp and a dynamo capacity of 172,101 hp, the kilowatt-hour output of current for the year being 259,105,461.

The total horse-power capacity of the steam engines and water wheels reported by the central electric stations, as used for the operation of dynamos to generate electric current is 1,772,813. Of this amount 1,379,941 hp, or 77.8 per cent., is the indicated capacity of steam engines and 392,872 hp, or 22.2 per cent., the stated capacity of water wheels. The indicated capacity of steam engines and water wheels in the stations operated under private ownership is 1,614,577 hp, or 91.1 per cent. of the total, and of those in stations operated under municipal control, 158,236 hp, or 8.9 per cent. The varying capacities of the steam engines is shown from the accompanying table:

STEAM ENGINES—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF THE TOTAL: 1902.

Class of engine.	Total.	Private stations.	Municipal stations.	Per cent. In private stations.	Per cent. In municipal stations.
Total:					
Number	5,930	4,870	1,060	82.1	17.9
Horse power	1,379,941	1,232,923	147,018	89.3	10.7
500 horse power and under—					
Number	5,450	4,407	1,043	80.9	19.1
Horse power	848,836	715,418	133,418	84.3	15.7
Over 500 and under 1,000 horse power—					
Number	279	266	13	95.3	4.7
Horse power	194,070	184,670	9,400	95.2	4.8
1,000 horse power and over—					
Number	201	197	4	98.0	2.0
Horse power	337,035	332,835	4,200	98.8	1.2

In general it appears from this table that private stations employ steam engines with a greater horse-power capacity than do municipal stations, practically all of the latter containing engines with a capacity of not over 500 hp. In addition to the engines shown there are reported for the private and municipal stations, 165 gas engines having a capacity of 12,181 hp, and 365 auxiliary steam engines having a capacity of 14,454 hp.

For all classes of stations 1,390 water wheels are reported in operation. Of this number, 113, all but 1 of which are operated under private ownership, possess a stated capacity of 1,000 hp and over. As in the case of steam engines, the smaller size of water wheels predominates, and wheels having each a stated capacity of 500 hp and under form 85.4 per cent. of the total number installed. Their horse-power, however, forms only 39.7 per cent. of the total horse-power. Only 8.1 per cent. of the water wheels have a stated capacity of 1,000 hp and over, but their total stated horse-power forms 47.2 per cent. of the total for all classes of water wheels.

We come now to the dynamos in central stations, 12,484 being reported of an indicated capacity of 1,624,980 hp. The accompanying table shows their character:

DYNAMOS—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Variety of dynamo.	Total.	Private stations.	Municipal stations.	Per cent. In private stations.	Per cent. In municipal stations.
Total:					
Number	12,484	10,662	1,822	85.4	14.6
Horse power	1,624,980	1,472,996	151,984	90.6	9.4
Direct current, constant voltage—					
Number	3,823	3,405	418	89.1	10.9
Horse power	442,446	418,913	23,533	94.7	5.3
Direct current, constant amperage—					
Number	3,539	2,957	582	83.6	16.4
Horse power	195,531	157,768	37,763	80.7	19.3
Alternating and polyphase current—					
Number	5,122	4,300	822	84.0	16.0
Horse power	987,003	896,315	90,688	90.8	9.2

The private stations contain 85.4 per cent. of all dynamos, and their horse-power forms 90.6 per cent. of the total horse-power of dynamos of every description. The showing of alternating and polyphase apparatus may be regarded as remarkable.

In addition to the equipment shown in the foregoing table, there are employed in the central stations 193 boosters, with a capacity of 17,911 hp, and 132 rotaries, with a capacity of 63,817 hp. As to sub-station apparatus, the number and horse-power of storage battery cells, transformers, rotary converters and miscellaneous equipment in sub-stations were required to be reported separately. The totals are summarized in the following table:

SUB-STATION EQUIPMENT—PRIVATE AND MUNICIPAL STATIONS: 1902.

Kind of equipment.	Total. Number.	Total. Horse power.	Private Stations. Number.	Private Stations. Horse power.	Municipal Stations. Number.	Municipal Stations. Horse power.
Storage battery cells	8,388	25,284	8,388	25,284	..	....
Transformers	2,525	420,667	2,490	419,368	35	1,299
Rotary converters	163	85,556	162	85,546	1	10
Miscellaneous	140	21,443	135	21,269	5	174

In addition to the 8,388 storage battery cells in sub-stations, with a capacity of 25,284 hp, there are 6,881 cells, with a capacity of 16,355 hp, reported for the main power plants, making the number of cells for all classes of storage batteries 15,269, with a capacity of 41,639 hp. It will, of course, be understood that the capacity of the storage batteries cannot be taken in definite horse-power, that depending so much on the rate of discharge; but the figures here given are such as are justified by the reports from the central stations as to battery output of current, although it was not found feasible to reduce this to horse-power-hours, the rate of discharge varying somewhat indefinitely.

In addition to the 2,525 transformers in sub-stations, with an indicated capacity of 420,667 hp, there are 207,151 on consumers' circuits, with a total capacity of 922,774 hp, making an aggregate of 209,676 transformers, with a capacity of 1,343,441 hp. The miscellaneous equipment consists largely of motor-generator sets and boosters.

Some difficulty was naturally experienced in getting at the output, especially with plants carrying chiefly an arc light load, or unchecked by consumption meters. There were reported, however, 582,689 consumers' meters, of which 98.7 per cent. were electro-mechanical, the others being chemical. Each station was required to report its kilowatt-hour average per day and the total for the year, and also the horse-power of the current average per day and the total for the year. In the majority of the stations no record is kept of the output of current, and the amounts reported are largely estimates based on the voltage and amperage of the machines with reference to the hours of operation. The average kilowatt-hour output of current per day for all stations is 6,814,074, and the total for the year 2,453,502,652. The horse-power-hours of current, average per day, is 9,097,796, and the total for the year 3,270,162,309. The stations operated under private ownership report 92 per cent., and those under municipal control only 8 per cent. of the total kilowatt and

horse-power-hours of current. The total dynamo capacity of central stations is 1,624,980 horse-power, or, roughly, about 1,200,000 kw. As the average kilowatt-hour output of current per day is shown to be 6,814,074, it appears from this that the electric light stations are on a basis of average daily operation for six hours, or, approximately, 25 per cent. of their possible capacity of production of current. As the gross earnings from operation are shown to be slightly over $84,000,000, and the total production of current for the year to be 2,453,502,652 kilowatt-hours, it appears that the earnings per kilowatt-hour are not quite 4 cents. On the other hand, it is not to be understood that the central stations are able to sell all the current that they produce, as the inevitable losses between the switchboard and the consumers' lamps and motors reduce the apparent earning capacity very seriously. But even if only half the current reported as produced were consumed and paid for and the other half were lost, the yield per kilowatt-hour would appear to be not in excess of from 7½ to 8 cents.

What becomes of the current used and sold is an important consideration, and a large amount of data is given bearing upon this point. As to the arc light service, the following table is of interest:

ARC LAMPS—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Kind of lamp and character of service.	Total.	Private Stations. Number.	Private Stations. Per cent.	Municipal Stations. Number.	Municipal Stations. Per cent.
Aggregate	385,698	334,903	86.8	50,795	13.2
Commercial or other private, total	173,973	168,180	96.7	5,793	3.3
Open	42,988	41,622	96.8	1,366	3.2
Inclosed	130,985	126,558	96.6	4,427	3.4
Direct current	104,176	101,849	97.8	2,327	2.2
Open	38,120	36,856	96.7	1,264	3.3
Inclosed	66,056	64,993	98.4	1,063	1.6
Alternating current	67,538	64,085	94.9	3,453	5.1
Open	3,733	3,631	97.3	102	2.7
Inclosed	63,805	60,454	94.7	3,351	5.3
All other	2,259	2,246	99.4	13	0.6
Open	1,135	1,135	100.0	.....	....
Inclosed	1,124	1,111	98.8	13	1.2
Public, total	211,725	166,723	78.7	45,002	21.3
Open	138,684	108,082	77.9	30,602	22.1
Inclosed	73,041	58,641	80.3	14,400	19.7
Direct current	154,749	119,520	77.2	35,229	22.8
Open	125,298	96,659	77.1	28,639	22.9
Inclosed	29,451	22,861	77.6	6,590	22.4
Alternating current	48,063	38,316	79.7	9,747	20.3
Open	4,630	2,681	57.9	1,949	42.1
Inclosed	43,433	35,635	82.0	7,798	18.0
All other	8,913	8,887	99.7	26	0.3
Open	8,756	8,742	99.8	14	0.2
Inclosed	157	145	92.4	12	7.6

In addition to the 385,698 arc lamps shown for central electric stations, the street railways operating electric light stations report 33,863 arc lamps, making the total in the United States 419,561. This does not include, of course, a large number operated in isolated plants of all kinds, as previously pointed out. The total annual income derived from arc lighting of every description, with the exception of isolated electric plants, is $27,408,708, giving an average of $65.33 per lamp, regardless of the daily hours of burning.

Of the total number of lamps reported for central electric stations, 334,903, or 86.8 per cent., are in use by stations operated under private ownership and 50,795, or 13.2 per cent., by stations under municipal control; 173,973, or 45.1 per cent., are engaged in commercial or other private lighting, and 211,725, or 54.9 per cent., in lighting streets, parks and public buildings; 181,672, or 47.1 per cent., are of the open variety, and 204,026, or 52.9 per cent., are of the enclosed. There are 258,925 lamps, or 67.1 per cent. of the total, operated by the application of direct current, and 115,601, or 30 per cent., by alternating current.

With regard to the lamps classified as "all other" this should be understood as referring to lamps which are not, strictly speaking, in the arc lighting category on private or public circuits. There are, throughout the country, a great many focusing and small projector lamps which are not known as arc lights, although the current is made to produce light by passing between two carbon points. These lamps are used in theatres, for stage projection purposes, in photographic studios, engraving shops, and daily newspaper offices for the quick production of photographs, engravings, etc. To add such arc lamps to the class devoted strictly to purposes of lighting buildings and streets would be misleading, and, therefore, the attempt has been made to segregate them as far as possible, although it will be understood, of course, that these are operated on the ordinary central station circuit.

Of the 334,903 arc lamps reported by stations operated under private ownership, 168,180, or 50.2 per cent., are used in commercial or other private lighting, furnishing an income of $8,220,154, or $48.88 per lamp; and 166,723, or 49.8 per cent., are used in public lighting, furnishing an income of $13,871,646, or $83.20 per lamp. Of the 50,795 lamps reported by municipal stations, 5,793, or 11.4 per cent., are used in private lighting, furnishing an income of $240,166, or $41.46 per lamp; and 45,002, or 88.6 per cent., are used in public lighting, with an estimated income of $3,149,079, or $69.98 per lamp. The income of municipal stations from public lighting is estimated for each station at the commercial rates prevailing in the community. The number of lamps, however, is not the number actually performing service at any one time, but only the number in position to render service, and, therefore, to earn an income. Including the lamps operated from stations controlled by electric railway companies, there are 195,122 of the open variety and 224,439 of the enclosed.

The general introduction of meters and the application of meter rates to the sale of electric current have made it unnecessary, and even impossible, to keep a record of the number of incandescent lamps in service, and in the majority of cases the numbers reported are estimates; but, while the totals are not the result of an actual count, they may be accepted as a close approximation of the actual number of lamps wired and ready for use at the end of the year covered by this report. The table herewith summarizes the totals for the United States and shows the proportion in private and municipal stations.

INCANDESCENT LAMPS—PRIVATE AND MUNICIPAL STATIONS, AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Kind of lamp and character of service.	Total.	Private Stations. Number.	Private Stations. Per cent.	Municipal Stations. Number.	Municipal Stations. Per cent.
Aggregate	18,194,044	16,616,593	91.3	1,577,451	8.7
Commercial or other private,					STAOIN SHRDLUUL
total	17,738,384	16,243,853	91.6	1,494,531	8.4
16-candle power	15,261,067	13,890,281	91.0	1,370,786	9.0
32-candle power	514,679	484,246	94.1	30,433	5.9
All other candle-power	1,962,638	1,869,326	95.2	93,312	4.8
Public, total	455,660	372,740	81.8	82,920	18.2
16-candle power	296,776	235,842	79.5	60,934	20.5
32-candle power	59,988	47,063	78.5	12,925	21.5
All other candle power	98,896	89,835	90.8	9,061	9.2

There are 16,616,593 incandescent lamps of all varieties reported for stations operated under private ownership. Of this number, 16,243,853, or 97.8 per cent., are used for commercial or other private lighting, and 372,740, or 2.2 per cent., for public lighting. Of the 1,577,451 lamps reported for municipal stations, 1,494,531, or 94.7 per cent., are used for commercial or other private lighting, and 82,920, or 5.3 per cent., for lighting streets, parks and other public places.

The total number of "all other candle-power" incandescent lamps, 2,061,534 is composed of small lamps of from 4 to 8 cp., used for advertising and decorative purposes, and of a comparatively small number of lamps of high candle-power, such as 50 candle-power. It is estimated that the equivalent in 16-cp lamps would be about half the number, or 1,030,767. Doubling the number of 32-cp lamps in order to reduce them to a 16-cp basis and including the incandescent lamps reported by electric railway companies, we have an aggregate equivalent of 19,171,544 as the number of 16-cp incandescent lamps wired and ready for use in the United States so far as central stations are concerned. The annual income from these lamps is reported as $48,222,108, or $2.52 per lamp. Reducing to a 16-cp basis the incandescent lamps reported for central electric stations, we have an equivalent of 17,737,944 lamps, of which 16,168,321, or 91.2 per cent., are operated by private stations, and 1,569,623, or 8.8 per cent., by municipal stations. Of the total number of lamps for both classes of stations, 17,271,744, or 97.4 per cent., are used in commercial or other private lighting, and 466,200, or 2.6 per cent., in public lighting.

The following statement shows the number of arc and incandescent lamps reported by private and municipal stations as used for commercial or other private and public service, and also the total annual income from each variety of lamp, with the average income per lamp:

NUMBER OF LAMPS IN SERVICE, TOTAL INCOME, AND AVERAGE INCOME PER LAMP.

Items.	Arc Lamps.		Incandescent Lamps.	
	Commercial or other private service.	Public service.	Commercial or other private service.	Public service.
Private stations:				
Number of lamps	168,180	166,723	16,243,853	372,740
Total income	$8,220,154	$13,871,646	$39,039,557	$2,257,927
Average income per lamp..	$48.88	$83.20	$2.40	$6.06
Municipal stations:				
Number of lamps	5,793	45,002	1,494,531	82,920
Total income	$240,166	$3,149,079	$2,868,296	[1]$491,322
Average income per lamp .	$41.46	$69.98	$1.92	$5.93

[1] Estimated value if paid for at prevailing rates.

There are 99,102 stationary power motors of all kinds, with a capacity of 619,283 hp, reported as being in operation by private stations, and 1,962, with a capacity of 5,403 hp, in operation by municipal stations, making an aggregate of 101,064 stationary motors, with a capacity of 624,686 hp. No inclusion is made, however, of fan motors, nor of the 2,370 railway motor cars served.

As to the circuits employed in the industry, the following figures are reported:

MILES OF ELECTRIC LINE CONSTRUCTION—PRIVATE AND MUNICIPAL STATIONS AND PERCENTAGE EACH CLASS IS OF TOTAL: 1902.

Items.	Total.	Private stations.	Municipal stations.	Per cent. In private stations.	Per cent. In municipal stations.
Total:					
Mains	107,263.63	93,352.95	13,910.68	87.0	13.0
Feeders	17,880.51	16,452.28	1,428.23	92.0	8.0
Underground—					
Mains	5,847.71	5,408.55	439.16	92.5	7.5
Feeders	2,276.55	2,262.02	14.53	99.4	0.6
Overhead[1]—					
Mains	101,383.76	87,913.13	13,470.63	86.7	13.3
Feeders	15,592.59	14,181.75	1,410.84	91.0	9.0
Submarine—					
Mains	32.16	31.27	0.89	97.2	2.8
Feeders	11.37	8.51	2.86	74.8	25.2

[1] Includes 79.50 miles of mains and 120.25 miles of feeders for electric railway service owned by lighting company.

There are 125,144.14 miles of main and feeder wires reported for both private and municipal stations. Of this total, 109,805.23 miles, or 87.7 per cent., are reported by private stations and 15,338.91 miles, or 12.3 per cent., by municipal stations. The mains and feeders for underground circuits measure 8,124.26 miles, or 6.5 per cent. of the total, and the overhead circuits 116,976.35 miles, or 93.5 per cent. Comparatively few stations have a record of the actual length of the wires strung and ready for service, but the amounts reported are careful estimates prepared by, or under the direction of, the management of each station. In several instances it has been found that electric light stations supply current to electric railway companies, and that, in the majority of such cases, the railway companies own the main and feeder wires over which this current is supplied. There are, however, 199.75 miles of mains and feeders for electric railway service owned by the central stations. These quantities are included in the statistics presented.

Paris Underground Roads.

According to recent dispatches, the city of Paris is to have another electric railway. The Council of State has approved the building of an underground railway from the Porte de Versailles to the Porte de Saint Ouen. Parliament has not yet given its final authorization, but should it be favorable the work of construction will be commenced in January or February next. Work in connection with the new line, No. 3, between Courcelles and Menilmontant is almost completed and the official inauguration will take place at the beginning of next year.

The Winter-Eichberg Single-Phase Railway System.

An English patent has been granted to Messrs. Winter and Eichberg, which discloses some of the features of the motor which is the basis of the single-phase electric railway system that has given such excellent results in trials made in Germany. We give below an account of such features of the motor as are disclosed in the patent, prefaced by some further matter relating to the system as a whole. The system of Messrs. Winter and Eichberg, which was taken up by the Union Electricitäts Gesellschaft, has been experimentally operated over two lines. One of these was a short section of track at the works of the company, the car being equipped with two 40-hp motors and a controller not differing greatly from that used with direct current. Single-phase current was supplied at 40 cycles per second, and the car was braked by short-circuiting the motors. This car is the first of twenty ordered by the National Railways Company, of Brussels, for the equipment of one of its lines.

The other line on which the system has been tried is two and a half miles long, between Johannesthal and Spindlersfeld, and a part of the Prussian State Railways. On this line a car has been in

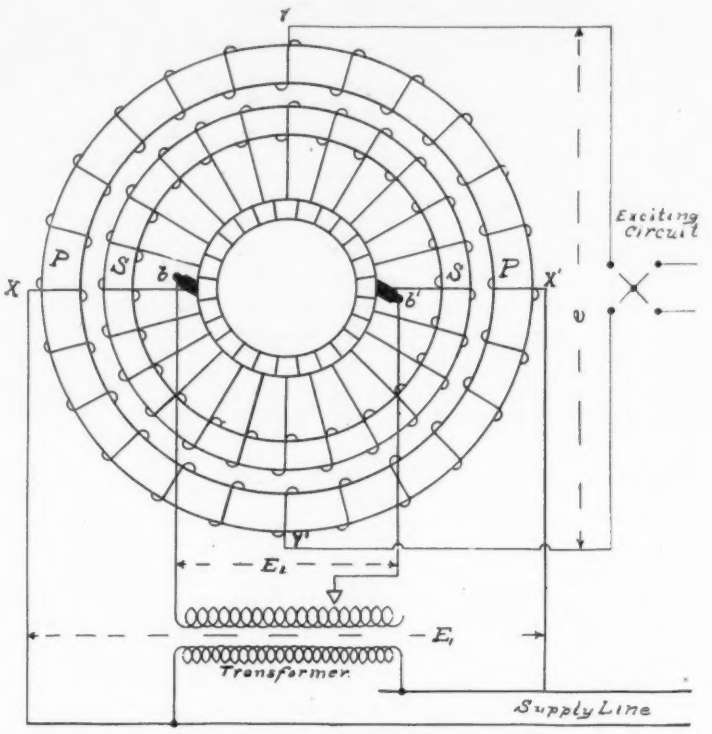


FIG. I.—DIAGRAM OF MOTOR WINDINGS.

regular service since last August. The car weighs 52 tons, of which total the electrical equipment comprises 6 tons. There are two motors mounted on the same truck, each of 120 hp, and the car has a controller at each end. The car has a small transformer which supplies current to drive the braking air pump, for the controllers and for the lighting service. The line voltage is 6,000, with a frequency of 25 cycles. The characteristic curves of the motors, which are connected in parallel, are given in Fig. 5. Two bows are used to collect the current from a single overhead trolley wire, and the rails are used for the return circuit. Figs. 2 and 3 give exterior views of the motors, and Fig. 4 of the manner of supporting the trolley wire. The trolley wire proper is hung from one or more bearer wires, this method eliminating the catenary curvature of the former and enabling it to be kept at practically the same height everywhere above the track. As will be seen, the bearer wire is supported from a rod which is borne by two insulators carried by two horns or brackets. Another advantage of this arrangement is that in case of a break in the wire the ends cannot hang down sufficiently low to endanger life.

The Winter-Eichberg motor, in common with all recent variable-speed alternating-current motors, is of the commutator type. Fig. 1 will serve to represent diagrammatically its connecting circuits for the purpose of giving an account of the theory of its operation, as disclosed in the English patent. As shown in Fig. 1, the motor possesses two windings, *P* and *S*, the primary and the secondary.

The secondary winding is joined to a commutator and is supplied with current at low e.m.f. by means of brushes connected to the low-potential side of a variable-ratio transformer. The brushes are placed in line with the points $x\,x'$, at which the high-potential current is supplied directly to the primary winding. The primary is tapped at its center at two points, $y\,y'$, where current for magnetization is introduced. The working current flows in the secondary by

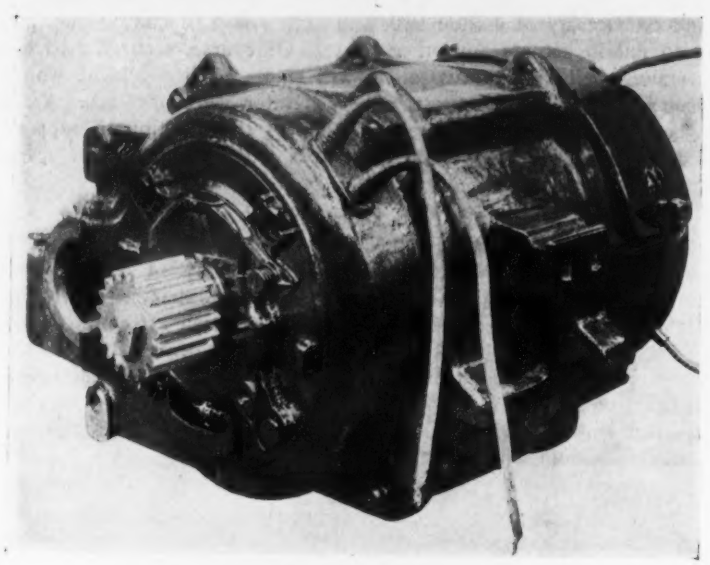


FIG. 2.—VIEW OF MOTOR.

way of the brushes and in the primary by way of the points $x\,x'$; while only magnetizing current enters the winding at points $y\,y'$.

It will be appreciated that, since points $y\,y'$ are symmetrically located with reference to the points $x\,x'$ of the primary winding, when current of any value or relative phase position is led into the windings by way of the points $x\,x'$, no difference of potential will be caused thereby to exist between y and y'; or, with reference to any current introduced by way of $x\,x'$, the points $y\,y'$ are equipotential. A similar course of reasoning will show that the points $x\,x'$ are equipotential with reference to any current entering the winding by way of $y\,y'$. This means that current introduced by way of $y\,y'$ flows

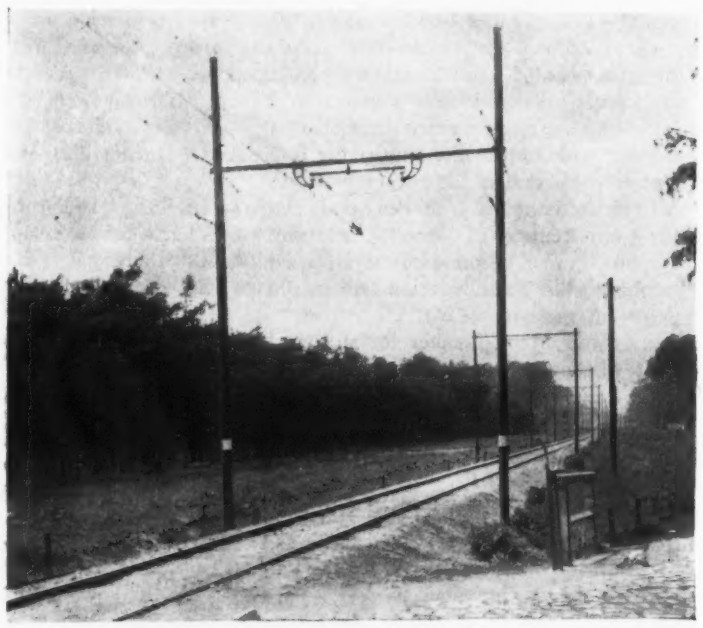


FIG. 4.—OVERHEAD CONSTRUCTION.

independently of any current entering from $x\,x'$, and conversely, so that, with the exception of the heating effect produced, each current acts as though a separate winding were provided for its use alone.

The magnetism due to the current through $y\,y'$ will have its axis in the line connecting y and y'. Current which enters the secondary by way of the brushes, $b\,b'$, will be in the proper mechanical position to produce a torque due to the presence of the magnetism on the line $y\,y'$. It is this torque which gives motion to the rotor. The torque, whose value depends upon the product of the field strength along the line $y\,y'$, and the current in the secondary, can be varied by altering either of these quantities. As shown in the diagram, there is provided a variable-ratio transformer by means of which may be changed at will the e.m.f. impressed upon the secondary.

Current which flows in the secondary has no effect in altering the value of the magnetism along the line, $y\,y'$, but it is in position to affect directly the magnetism along the line $x\,x'$. Since the primary e.m.f. applied at the points $x\,x'$ and which is kept at a constant value, demands a certain definite amount of magnetism to produce by its

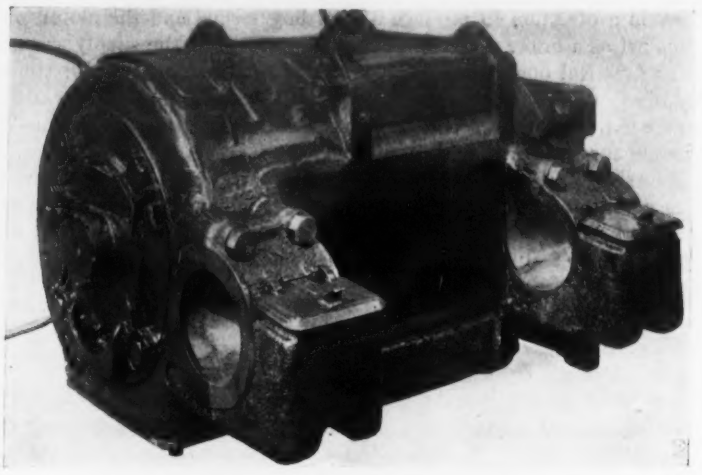


FIG. 3.—VIEW OF MOTOR.

rate of change a corresponding counter e.m.f. in the primary windings, current in the secodary coil is directly opposed in magnetomotive force by current in the primary; that is to say, independently of the motion of the rotor the current in the conductors thereon acts as though it flowed in the secondary coils of a stationary transformer. The value of this secondary current depends inversely upon the impedance of the secondary circuit and directly upon the difference between the secondary impressed e.m.f. of the secondary. When

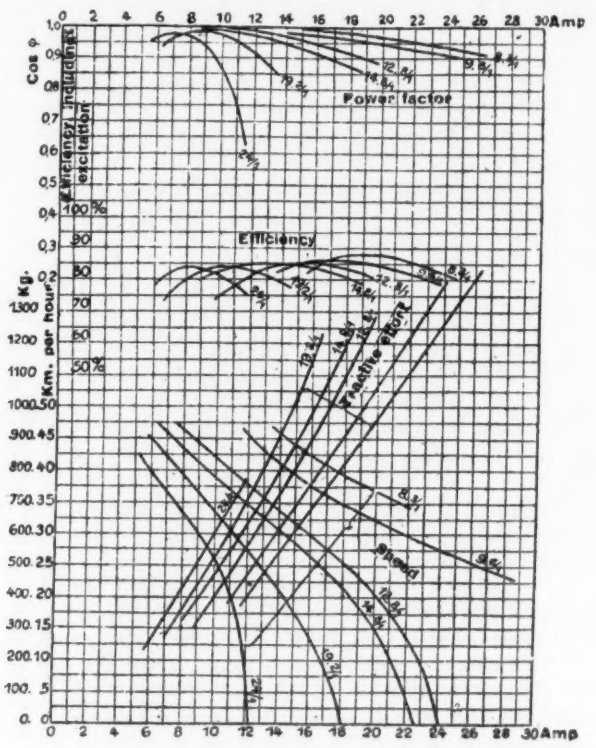


FIG. 5.—CHARACTERISTIC CURVES.

the secondary is stationary, the internal generated e.m.f. is that due to the rate of change of the magnetism along the line $x\,x'$, and if the secondary impressed e.m.f. is equal to the primary e.m.f., divided by the ratio of transformation of the stationary transformer, no working current will flow in the secondary windings. A greater value of secondary impressed e.m.f. will cause to flow a current which will produce a torque tending to give motion to the rotor.

When the rotor is in motion, its conductors cut the magnetic lines

along $x\,x'$, and there is generated an e.m.f. which appears as a maximum at a position upon the commutator in quadrature to the field; that is, at the brushes $b\,b'$, and it is in a direction to decrease the effective e.m.f. of the secondary. Thus, with increase of speed, the secondary current is decreased and the torque is reduced thereby. Additional torque can, however, be obtained at increased speed by augmenting the impressed secondary e.m.f.

If the speed of the rotor is such as to generate in the conductors due to cutting the field along $x\,x'$, an e.m.f. greater than the difference between the e.m.f. due to the alternating field along $x\,x'$ and the impressed secondary e.m.f., then the current in the secondary will flow in a direction to produce a retarding torque and the motor will thus act as a brake and will also restore energy to the supply system.

In practical operation, the line voltage of suitable value for transmission is impressed directly upon the primary windings, while a low e.m.f. suitable for commutator operation is derived by transformation for the secondary circuit.

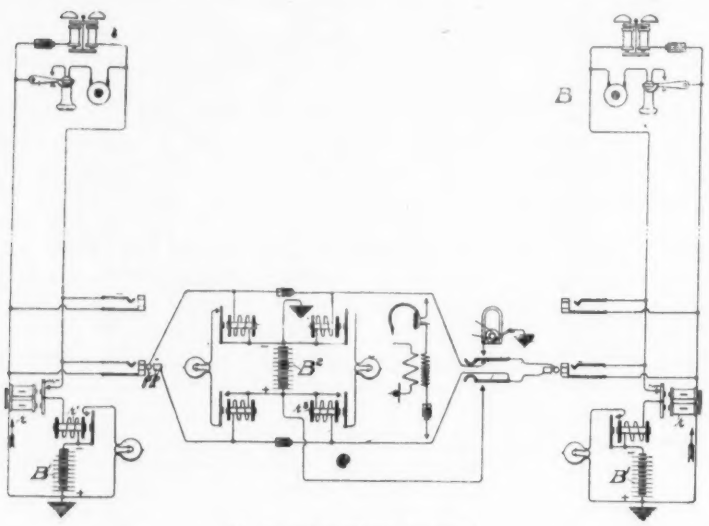
Messrs. Winter and Eichberg, in their patent, have devised numerous connections of circuits for the application of the principles enumerated above. The illustration given is intended merely to cover the essential features of the new motors without introducing undue complications.

New Telephone Patents.

IMPROVEMENT IN TWO-WIRE COMMON BATTERY SWITCHBOARD.

The practicability of a two-wire common battery switchboard once having been demonstrated, many different schemes for arranging the circuits were almost at once forthcoming, and even yet every few weeks a patent appears for some new idea along this line. The latest is that of Mr. W. W. Dean, of Chicago, embodied in a patent recently granted. This new idea consists in the use of a polarized cut-off relay in such a manner that all relay contacts are removed from the talking circuit. The advantage of this is at once evident.

The operation of the system is best explained by referring to a



DEAN TELEPHONE SYSTEM.

diagram of connections such as shown in the accompanying figure, in which are represented two subscribers' lines and one pair of connecting cords. As will be seen, the cut-off relay, r, is legged to ground from the thimble side of the two point jack, and it is so polarized as not to respond to the line signal current from battery B', which will, of course, pass in the direction of the arrow from positive out through the line to negative. When, however, the cord-circuit battery of reversed polarity is tapped on by the insertion of a plug in the jack, the cut-off relay current at once reverses in direction. The relay, properly polarized, at once responds to cut off the signal circuit at its single contact. Mr. Dean has assigned his patent to the Kellogg Company.

AN ODD PARTY LINE SYSTEM.

An odd scheme for a selective party line system is described by Amos Gagnan, of Stafford Springs, Conn., in a patent just granted to him. At each station he proposes to use two adjustable bell-controlling relays, so wired in the bell circuit that one must fail and the other operate in order that the bell may ring. At each station, also, is a hand generator and an adjustable rheostat, the joints of the latter being numbered to correspond to the various stations. Now the current which the generator will send through resistance number one should pull up one relay of station one, and fail to pull up any other relay on the line. Bell one alone will then respond. Again, the current through point two of the rheostat is to affect one relay of station two, and both relays of station one, but is to fail to actuate any other relays. Of course, according to the premises, bell number two alone will ring. Such a scheme would probably work if a power ringing generator were provided. With a hand generator it seems entirely out of the question to suppose that all users will drive the generators within the required speed regulation.

A NEW HOOK SWITCH.

The Stromberg-Carlson Company has obtained by assignment the patent for a well-designed hook switch, the work of Nels August Engstrom, of Chicago. The base of the hook bar is so shaped that a bell crank lever is formed, the prongs being at the extremity of one of the arms, and an insulating roller stud being carried at the extremity of the second arm. This stud serves as the wedge of a switch consisting of spring members assembled exactly after the manner usual for switchboard keys. The result is a substantial though positive switch.

TELEPHONE BRACKET.

A fourth patent of the issue under consideration concerns a folding telephone stand set desk bracket, designed upon the principle of the "lazy tongs." Intermeshing gear sectors provided upon the base and end members of the tongs restrain the axis in a horizontal position when the base plate is properly mounted upon the side of a desk. The patent brings out no particular merit in this bracket over its predecessors.

Recent Electrochemical Developments.

Only three patents were granted on December 8th relating to matters electrochemical. Mr. Sakizo Yai, of Tokio, Japan, patents a modification of the Leclanche cell, consisting of an outside zinc cylinder and a graphite rod in the center. The space between the graphite rod and the zinc cylinder is divided into two parts by means of a porous cylinder, preferably formed of blotting paper. The space between the zinc cylinder and the porous cup is filled with zinc oxide, and the space between the carbon rod and the porous cylinder is filled with a mixture of manganese oxide and graphite powder. A solution of caustic potash is then poured into the cell. When it is charged by means of the electric current the manganese oxide is converted into a higher oxide, while the zinc oxide is reduced. During discharge the chemical action is the reverse.

Mr. M. R. Hutchison, of Norwood, N. J., patents a device for the sealing and venting of batteries, whereby gases have a free escape, while the liquid solution is effectively sealed in, and whereby it is easy to replenish the liquid solution that may have been evaporated.

A patent granted to Mr. H. Garret, of Dallas, Texas, relates to an automatic circuit-breaker for storage batteries, which breaks the circuit whenever the voltage of the charging current drops below a certain value, and automatically closes the circuit again when the voltage of the power lines resumes the proper figure. Such a device is of importance, since if in case of an accident in the power house or on the line the voltage of the charging current should drop too low, the battery would discharge into the mains if the circuit was not broken.

Ohio Engineering Society.

The Ohio Society of Mechanical, Electrical and Steam Engineering held its seventh annual meeting at Canton, Ohio, recently. Mr. R. H. Probert, of Akron, was elected president; Henry Jackson, of Steubenville, vice-president, and O. C. Pillichody, of Steubenville, treasurer. It was decided to hold meetings semi-annually hereafter, instead of three times a year. Each annual meeting will be held at Canton, as required by the constitution. The next meeting will occur in Columbus. Among the papers read was one by P. F. Moock, of Canton, on "Some Power Plant Economics." Other papers of an engineering character were also read.

Engineering Features of the St. Louis World's Fair—A General Review.

SO many reports are now finding their way into print regarding the various electrical and mechanical engineering features of interest at the Louisiana Purchase Exposition that a brief general summary of some of these principal features as definitely arranged for up to date may be of value. Some of these principal features already noted in these pages can be enumerated as follows:

1. The service power plant in the Machinery Building, consisting of four 2,000-kw units, with boilers in the Steam and Fuels Building.
2. The exhibit power plant in the Machinery Building, consisting of various prime-movers, such as steam engines, gas engines and steam turbines, all connected to dynamos furnishing current for exposition uses, and also including the boiler and gas plant located in the adjoining Steam and Fuels Building.
3. Illumination of grounds and buildings.
4. Cascade pumping plant, which produces an artificial waterfall of considerable size forming the center of the Exposition picture.
5. Steam and electric railway exhibits, including locomotive testing plant and facilities for electric railway motor tests, both of which features it is hoped will contribute substantially to the fund of engineering knowledge before the Exposition season closes.
6. The exhibits in Electricity Building.

GENERAL POWER SUPPLY.

The power supply to an exposition of this size calls for the utilization of all the exhibit power apparatus possible. The illumination of such immense buildings and areas as this exposition has, together with the large number of electric motors to be used, calls for great outlay in electric generating machinery. Practically all the engines and dynamos in Machinery Building will be operating exhibits and contribute to the general power supply. The necessity for this fits in very well with the prevailing idea of the Exposition management, as announced at the outset, which is, to make this an operating exposition showing machinery and processes of manufacture in operation.

SERVICE AND EXHIBITION POWER PLANTS.

The Exposition management, in enumerating the sources of energy that will be available for exposition purposes, is in the habit of considering that it has three such sources, although two of them are closely allied. The service power plant in the Machinery Building will have a nominal capacity of 8,000 kw in 25 cycle, 6,600-volt current. The Exposition will purchase from the Union Electric Light & Power Company about 7,500 kw of the same kind of current. Besides this there will be available miscellaneous exhibit engine and generating apparatus to the amount of about 20,000 kw, though the steam and gas supply will probably not permit this full capacity to be utilized at one time.

The main service power plant in Machinery Hall, with boilers in the Steam and Fuels Building, is now being installed, the contract for this entire plant having been given to the Westinghouse companies. This plant will have four 2,000-kw generators, direct-connected to vertical Corliss engines, supplied from 16 B. & W. boilers in the Steam and Fuels Building. The contract includes switchboard and, indeed, the complete plant, with the exception of the buildings in which the machinery is placed. The plans for this plant will be taken up in detail in a later issue. The output of this plant being of the same voltage and frequency as the outside supply, these two sources of energy are interchangeable with each other and if thought best can be operated in parallel with each other.

The exhibit power plant in Machinery Building will, of course, have an immense variety of apparatus which it is not necessary to catalogue in a general article of this kind, but some of the features which will certainly attract the engineer will be the steam turbines of the Parsons, Rateau, De Laval and Curtis types, and several large gas engines. The largest steam engine unit will be a duplicate of the 5,000-kw units in the Interborough station in New York, and the largest turbine, a Curtis of 4,000 kw. All engine and turbine units will be direct-connected to dynamos, the belt having at last disappeared in exposition power plant work in this country.

The Steam and Fuels Building is the name that has very properly been chosen for the building 100 ft. west of the Machinery Building, where the steam boilers and gas plants will all be located. It seems that the gas engine is to take a prominent part in this exposition. The steam boiler capacity will be 23,000 hp, according to the usual boiler rating. A dozen foreign and American boiler makers will be represented by their products in this building. The boilers will be principally of the water tube type.

As to fuel, oil was, of course, given much consideration at first, but was abandoned because of the uncertainties of delivery of the necessary 1,400 to 1,600 barrels per day and the high price as compared with coal. By the use of mechanical stokers and by making some of the fine coal into briquettes, it is hoped to make combustion sufficiently smokeless to be inoffensive. Briquettes can be made from the tar by products of gas manufacture. The gas made by the gas plants can either be used directly in gas engines or used under boilers instead of coal.

ILLUMINATION.

The illumination of buildings and grounds of modern expositions, and especially of those in America, has become such a prominent part of the show and the standard set by the Pan-American in this respect was so high that the Louisiana Purchase Exposition will have difficulty in providing anything which is a radical advance in general lighting effects. The areas and buildings are so much larger than were those at the Pan-American, however, that even an equally good illumination would not fail to have its effect on the popular eye.

The incandescent lamp has wisely been chosen for the outside night decoration and illumination, and the majority of lamps will be of 8 cp. The effectiveness of the Omaha and Pan-American illuminations, which were the first to use the incandescent exclusively, left the St. Louis Exposition engineers but little choice in the matter. The buildings will be outlined with incandescents and the main areas and lagoons illuminated by the same means. The main areas of the Exposition cover about 500 acres and consist of a number of courts radiating from a common center known as the Cascades. The view toward the Cascades from all these courts has the Cascades and high ground for a background, which makes a very impressive setting, as can be seen even at this incomplete stage of the work. The Cascades give opportunity for many beautiful illuminated water effects, by the use of projector lamps throwing different colored rays on the water. It is expected to make use of the Cooper Hewitt lamp in securing some of these effects, because of the peculiar quality of the illumination it can give the water. The arc lamp will be used for the interior illumination of buildings. An order for 300,000 incandescent lamps was placed with the General Electric Company last week.

CASCADE PUMPING.

The Cascade pumping plant, which is to produce continuously a gigantic artificial waterfall, is to have a capacity of raising 90,000 gallons of water per minute a height of 154 ft. It will be located beneath one of the Cascades on the hillside and will probably be the largest pumping plant of the kind ever built. It will have 2,000-hp Westinghouse induction motors direct-connected to Worthington centrifugal pumps, running 165 r.p.m. These will be the largest induction motors ever built and probably the largest centrifugal pumps. It is figured that this pumping plant will circulate the water in the lagoons once every 4½ hours, which certainly ought to prevent it from becoming stagnant or foul with refuse matter thrown into it. To prevent having too strong a suction at any one point, the suction pipe is carried 1,500 ft. down the main lagoon, with screened openings along its length for taking in water at various points, and keeping the velocity low at any one point. A 90-in. suction pipe is required. The water is to be filtered before the lagoons are filled with it and the pumping plant simply draws from and discharges into the lagoons, acting as an aerating and circulating plant, as well as producing a necessary adjunct to the main vistas of the Exposition.

RAILWAY EXHIBITS AND TESTS.

Besides the stationary exhibits of cars, trucks and locomotives in the Transportation Building, a $100,000 locomotive testing plant is being installed by the Pennsylvania Railroad Company in Transportation Building. Applications have already been made to have tested more locomotives than can be tested during the Exposition season, and probably the testing will have to be continued after the season is over, or possibly the testing plant made permanent.

For electric railway tests, one track 3,000 ft. long and one 1,400 ft. long parallel with the intramural railway back of the Transportation Building are available. The short track can be used for imitating the conditions of city surface lines, and the longer stretch for testing higher speed motors. Two types of single-phase railway motors have been promised for test, which is a point of considerable practical interest just now.

Although not in the Electricity Building, these tests and exhibits

of electric railway apparatus come under the department of electricity. The exhibits in Electricity Building are not sufficiently decided upon to permit of detailed mention. Owing to the pressure of the prime-movers in the Machinery Building, all the operating generating machinery will be found there.

Owing to the size of the grounds, transformer sub-stations (and rotary converters, if necessary), will be put in the various buildings, and high-tension transmission lines will supply these sub-stations.

The electrical and mechanical department of the department of works, which department is responsible for the lighting and power of the Exposition, has been under the charge of Henry Rustin, as chief, who occupied similar positions at Omaha and at the Pan-American. Mr. Rustin having been obliged to leave his post on account of his health, Edward B. Ellicott has assumed the duties of acting chief during Mr. Rustin's absence.

The exhibits in Machinery Building are under the charge of Thomas M. Moore, chief of the department of machinery, and electrical exhibits are under Prof. W. E. Goldsborough, chief of the department of electricity.

New Year World Time Signals.

The United States Naval Observatory at Washington, D. C., has announced the details of its scheme to send telegraphic time signals throughout the world to mark the beginning of the new year. The signals were sent out last year for each of the four great standard time belts of the United States. This year it is proposed not only to secure a wide distribution of these new year signals throughout North and South America, by the co-operation of the telegraph and cable companies, but also to send one or more of the four series of signals around the world and back to the room in the Naval Observatory where they started. The signals will begin at 11.55 P.M. and end at midnight, Eastern time. The same series will be sent out an hour later, ending at midnight, central standard time; again an hour later, ending at 2 A.M., for midnight of mountain standard time, and again an hour after that, ending at 3 A.M., for midnight of Pacific Coast standard time. During each of these four five-minute intervals the transmitting clock will send an electric impulse practically every second.

On the world circuit signals will go by land lines to Cape Canso, N. S., thence by cable to the Azores, Lisbon, Gibraltar, Malta, Alexandria and Port Said; by land to Suez, by cable to Aden and Bombay, by land to Madras, by cable to Penang, Singapore, Saigon, Hong Kong, Manila, Guam, Midway, Honolulu and San Francisco, and by land back to Washington. It is proposed to receive both the outgoing and incoming signals on the same chronograph at the Naval Observatory, and thus preserve a permanent graphic record of both on a single sheet of paper. It is suggested that, besides demonstrating the possibilities of practical astronomy and telegraphy, working together through international co-operation, benefits will result from the general attention that it will direct to the advantages of the use of accurate standard time throughout the world.

Peat Coal by Electrical Process.

Note is made in the United States Consular Reports of peat coal making by electricity in England, where at the works of Messrs. Johnson & Phillips, at Charlton, in Kent, there has been exhibited during the past month an electrical process for converting ordinary peat into firm, smokeless steam coal at a cost which promises to bring the product far within the industrial price limit of steam fuel in Great Britain and Continental Europe.

The peat is cut and excavated by machinery, loaded into dumping cars, which convey it from the bog to the plant, where it is packed into rotary iron cylinders of a peculiar construction. The cylinders being rotated at high velocity, the centrifugal pressure, aided by an interior beating device, expels all but a small remnant of the 80 per cent. of water which the material originally contained. Electrodes connected by conductors with a dynamo are then inserted in the cylinders in such a manner that the mass of centrifugally-dried peat becomes the medium through which is completed the circuit between the electrodes. The resistance offered by the peat, like the filament of an incandescent lamp, generates heat which carbonizes the material, producing a mass of disintegrated black globules, which retain all the valuable elements of the original material. This part of the process, which depends largely upon the conductivity of the peat, may be promoted by moistening the mass with certain cheap liquid chemicals, the use of which is covered by the patent.

From the cylinders the carbonized material passes to machines, which knead it into a putty-like mass, which is then pressed into briquettes or left to dry and harden in masses, which are broken into lumps, screened and graded like ordinary coal. Among the special advantages claimed for this method is the fact that the electrical current converts but does not destroy any of the valuable elements of the peat, whereas coking by fire heat expels a large percentage of these elements in the form of gases, which, being either wasted or burned as fuel beneath the retorts, are lost from the composition of the ultimate product.

Briquettes produced by this method can be compactly stowed on shipboard or elsewhere; they are practically smokeless, leave no clinkers whatever, and, according to English press reports, have the high thermal value of 9,000 British units. The cost of a plant capable of treating 100 tons of peat per day is stated to be £4,000 ($19,466). The actual cost of producing one ton of peat fuel by this process is stated to be 5s. ($1.21), equal for all steam-generating purposes to a ton of South Wales steam coal, which costs at the mouth of the mine 8s. 4d. ($2.02). These are given as the economic results in a location where the electric current used by the process is generated by steam. In districts where generators can be driven within a working radius of peat bogs by water power, the cost of production would be proportionately reduced. The method is now to be tried in Ireland.

Mr. Westinghouse on the Steam Turbine.

Confirming what has already been forecast in these pages, Mr. George Westinghouse made, last week, the important announcement that for the Westinghouse Machine Company, of Pittsburg, he has acquired from Mr. C. A. Parsons the full rights to manufacture in the United States and Canada the well-known Parsons steam turbines for all purposes, including marine propulsion, and that a special department will be organized at the works for the introduction of this remarkable engine, in order to more effectively promote its use upon all classes of vessels, including warships of every type. This new department will work in close touch with all the steamship builders in the country.

Mr. Westinghouse, when interviewed, said: "The steam turbine is not a new and comparatively untried invention, as many laymen seem to think. There are half a million horse-power of Parsons steam turbines in daily operation in different parts of the world; eighty-four thousand horse-power of these are in steam vessels. In the United States alone there are 60,000 horse-power of the stationary type used in connection with electric light and power in continual operation, and 150,000 horse-power more are already contracted for and now under construction at Pittsburg, where units as large as 8,000 horse-power are being built. The impression in the public mind that the steam turbine is a new thing, is probably due to the fact that attention is frequently called to new makes of turbines. The fact is, these new types have not demonstrated any superiority over the Parsons, which is the only turbine of world-wide repute and operation, and is the only one which will give, or is at present capable of giving, highly economical results. Other turbines have made claims to economy, but they justify these claims only when they borrow the Parsons idea, which is fundamental. I have made a broad investigation of this question, with the result that the Parsons turbine is the one with which I have concluded to ally my interests. We shall build up a great marine turbine industry in the United States. The importance of the marine turbine has not been overestimated, and it is long past the stage of experiment. For passenger ships, freight ships, yachts and for battleships, not less than for torpedo boats, the turbine is unquestionably the best engine. For pleasure craft the turbine surpasses all other forms of engine, because of its absolute freedom from vibration. Its compactness recommends it for all classes of vessels. In torpedo boats the saving of room is needed to accommodate other machinery. In naval cruisers and battleships, the engines lie so much closer to the ship's keel as to make them far less likely to be injured by the enemy's shots. We need not call the turbine the engine of the future, it is decidedly the engine of the present."

Convention of the Interstate Independent Telephone Association.

IN our issue of last week a telegraphic report was given of the opening sessions of the Convention of the Interstate Independent Telephone Association, including an account of the extensive exhibits of manufacturers. Below we present a fuller account of the proceedings up to the time of adjournment.

In welcoming the convention as the representative of Mayor Harrison, Mr. David R. Levy said that the Association stood for the independent element in business, and it is this element which in these days is unfortunately kept in the background. Vast aggregations of capital are controlling almost every line of business and the small man is either pressed into a corner or put out of business. He therefore wished to compliment the Association, representing as it does nine great commonwealths, on the great strides it has made independent of such aggregations of capital, and in fact against one of the largest capitalized institutions in the country. The independent spirit which it represents is one that Chicago fosters. The Association has grown from two or three men fighting a gigantic monopoly to where it is recognized in the commercial world. He wished it every success and prosperity, and in behalf of the Mayor of the city of Chicago he offered the freedom of the city.

In his presidential address Mr. Hull said that it is unfortunately true that taken as a whole independent telephone companies have, in a great degree, lived each for itself. Feeling strongly intrenched in its own locality, the disposition has been to get all that could be gotten and to keep it. This disposition upon the part of some of the large operating companies has driven from the ranks many who would have preferred to remain independent operators. President Hull urged that the matter of a press committee be taken up and he pointed out the desirability of informing the people in all quarters of the country of the merits of the fight the independents are making. It is difficult to win against public sentiment and it is the duty of the Association to create and foster an aggressive sentiment in favor of the independent movement, both on the score of public good and as an avenue for sound financial investment.

Secretary Coleman, in addition to the statistics contained in our telegraphic report, said that 175 cities having a population of over 20,000 now have independent exchanges in operation, and that the earnings of the independent companies in this country are best illustrated by the statements of 20 large companies during a period of four to five years, which show net earnings of from 8 to 16 per cent. The statistics which he gave as to the number of subscribers did not include many rural companies' lines and small systems aggregating at least 500,000 telephones actually in use. To illustrate the effect of the independent movement he said that eight years ago there were only between five and six thousand telephones of every sort in the State of Indiana, while there are now 80,000 independents and 22,000 Bell telephones in that State.

He referred to the methods adopted by the Bell Company in fighting the independent movement. At first its practice was to buy up independent telephone exchanges, but these came so thick and fast that this finally proved an impossibility. The next plan was to wait until a cluster of towns in one particular section of the country was built up and one became necessarily the center of the cluster, when this latter would be purchased, thus seriously affecting the surrounding exchanges. At present the plan is to persuade small exchanges to connect with Bell toll lines, with the result that when it is attempted to start an independent toll line they find that the independent exchanges in the territory are bound by toll line contracts with the Bell interests. Mr. Coleman said that the latest scheme of the Bell Company is to get control of the outside manufacturing telephone interests. He referred to the Kellogg Company and said that the air is full of current reports that other manufacturing establishments are in one way or another connected with the Bell Telephone Company.

He strongly urged that the Interstate Independent Telephone Association, which at present has representation from only nine States, be extended to cover the entire United States. He suggested that the headquarters of the Association should be the general headquarters of the independent telephone movement in the country, with a power delegated to it under the executive board to exercise general supervision and watch over the operating companies of the country; and that a general information bureau should be established by which should be disseminated information of every sort calculated to build up the independent telephone business of the country, and to counteract influences working against it. He considered absolutely imperative the necessity for adopting co-operative plans, alliances and legitimate combinations to combat an organized competitive foe, and to protect their own interests and those of others against alleged independent operating companies and alleged manufacturing companies that have dealt or would deal with the enemy.

The report of Secretary Coleman was referred, for thorough investigation of its recommendations, to outline action and to report to the convention at the earliest hour possible, to a committee consisting of the president and a member from each State represented in the Association.

A motion for the appointment of a committee to call upon the Illinois Telephone & Telegraph Company for the purpose of obtaining terms and conditions for connecting the toll lines of the territory of the Interstate Association with the exchange now being installed in Chicago, led to considerable discussion, in which the extreme desirability of an arrangement which would enable their companies to connect with Chicago was dwelt upon. A motion for the appointment of such a committee was unanimously carried. Subsequently a motion was passed asking that a committee be appointed to wait upon the Illinois Telephone & Telegraph Company and ask President Wheeler to come before the convention at one of its sessions and favor it with a detailed statement as to his plans with respect to the independent telephone interests. At the session of the following day the committee reported that President Wheeler had informed them that his company is at present operating a switchboard in Chicago with about 4,000 subscribers and that within the next 30 days they expect to have 10,000 of the business men of Chicago connected up. They had been so very busy that thus far no attention had been given to the long-distance feature. They wanted it distinctly understood, however, that they were independent in the telephone field, perhaps more so than any of the independent telephone companies, and that early in the spring they proposed to take up the question of making long-distance connections. The committee was assured that as soon as it was practicable to do so, they would make long-distance connection with any company proposing it having metallic lines and that could furnish good service. He said it would be as advantageous for his company to have the suggested long-distance connections as it would be to the independent companies.

At the opening of the session on Wednesday, the Hon. Theodore Gary, of Macon, Mo., delivered upon request an address giving his views concerning freight rate classification and the treatment by railroads of small exchanges along their lines. Among the points mentioned was that freight rates for dry batteries are based on the same classification as for the old wet battery, and that it costs about 4 cents apiece to get them to the western part of Missouri from Cleveland. He considered that something should be done toward getting a proper classification on dry batteries. Another injustice is in the matter of returning reels. Some of the railroads classify reels higher than the original shipments, and in no case is there any reduction given as is the custom in most other cases. A very great injustice is the demands made by railroads on smaller exchanges for free service, and if they do not agree the telephones are ordered out. As subscribers need this service the telephone companies are generally compelled to accede.

Mr. Holdole, of Iowa, said that the independent companies are paying four or five times the freight rate on telephone instruments that is paid on sewing machines. The discussion brought out that wherever they could do so, the railroad and express companies insist upon having free service.

The committee appointed to consider the recommendations of Secretary Coleman recommended the appointment of a committee to prepare a suitable constitution and by-laws for the Association; that the Association be incorporated; that it shall be an organization covering the present States in the Association, together with such other States or Territories as it may be deemed expedient to admit; that the membership fee for any operating exchange company, toll line company, individual or corporation, be fixed at $5 per year with an additional tax, if necessary, based upon the number of toll line miles or the number of telephones in an exchange; that uniform contracts for toll line connections and as far as possible uniform rates in exchanges be based on telephones in operation.

One of the enlivening features of the convention was a discussion concerning the presence at the meeting of men having connection of one kind or another with Bell interests. Several were de-

nounced by name, and of these two took the floor to defend themselves.

In the absence of Mr. W. C. Polk, a paper contributed by him entitled, "Standardization of Construction," was read by Secretary Coleman. Mr. Polk is very skeptical as to the possibility of any considerable opportunity for standardization. Commencing with conduits, he stated that there are the single-duct, multiple-duct, clay conduit, iron pipe, cement lined pipe, cement conduit, paper conduit, creosote wood, etc., all of various sizes and shapes, laid in a variety of ways. The manufacturers claim each to be the best, cheapest, most durable, and he who would decide which shall be the standard and how it shall be laid will have a difficult problem. The same is true with respect to a decision concerning poles, as to whether they shall be of chestnut or white, red, Northern or Western cedar, cypress or tamarack, and whether they shall be 4 in. in diameter at the top or 5, 6, 7, 8 or 9 in., or even greater, or whether the heights shall be 20 ft. or 60 ft. Mr. Polk also mentioned wire and cable as other material which it would be very difficult to standardize, and he said that one could go through the entire list of construction material such as cross arms, cable boxes, terminals, protectors, hardware, etc., and meet with the same situation. In view of these facts it is certain that it would not be safe or wise to decide, at the present time at least, what shall constitue standard construction.

He does not believe that it is either possible or practical to have a standard of construction in the independent telephone field, owing to there being such a large number of separate and distinct organizations, each with its individual and personal ideas which each insists upon following regardless of results; and also owing to the large number of manufacturers and supply houses from whom it is possible to purchase material and equipment precludes the possibility of early standardization. All of these manufacturers produce certain articles which are good and which any operating company could wisely purchase. Moreover, owing to the recent development of the business, independent telephony is at present in an evolutionary stage, and progress in improvements should not be retarded for the sake of keeping up to a standard. Notwithstanding the fact that the Bell company purchases its equipment and supplies practically from one and the same source, it has been unable so far to reach a satisfactory standardization of its equipment or methods of construction; and the fact of its failure to standardize equipment and establish uniformity of methods of construction indicates that there are very formidable barriers to overcome.

Mr. Polk considered, however, that although it may not be possible to bring about an absolutely uniformity, it would be well to begin to formulate plans to attain as much uniformity as possible. He suggested a national board composed of experienced and practical telephone engineers and construction superintendents made up from representatives from all parts of the country, familiar with all the conditions and operating features in the various localities. This board could have a standing committee to which financial men and investors could apply for advice. The operating owners and managers in the various sections could be kept advised by this committee, upon which they could feel at liberty at any time to call. All important matters, however, should be referred to the general board, and especially all new propositions or large ones calling for new and large investments. In this way the new investor or new operator would have a source to which he could turn at any time for advice, which would be conscientiously and intelligently furnished. Membership in this national organization should be very carefully chosen. Only persons of certain minimum number of years of actual experience and practice in construction and maintenance of telephone properties should be chosen, as the membership should consist largely of practical engineers and superintendents of construction and not of owners and investors. The expense of the maintenance of such an organization should not be great, and it could be maintained by the various telephone associations.

In the discussion on the papers by Prof. Kelsey[1] and Mr. Polk, in answer to an inquiry, the former said that No. 6 copper wire ought to carry 1,000 miles, and that No. 10 copper wire would work 500 miles, but not so satisfactorily as No. 8. No. 10 would be suitable for four or five hundred miles if the instruments and circuit are clear. Mr. Meyer said that to some extent standardization is practicable, particularly with respect to toll lines in relation to the size of copper, the spacings of the wires, etc. Mr. Thompson said that in Ohio there are just about as many different kinds of telephone instruments as there are telephone companies, and that the quality is probably a good deal worse than that number. This is the result of two things: First, the want of business capacity on the number of persons who did the buying, and second, the want of information, which should be furnished by such organizations as the Association to the public press and through other means of disseminating information. He believed that standardization of apparatus is possible because energetic business men and telephone associations are beginning to realize that they cannot run the telephone without a standardized equipment. He referred to the analogy of the present telephone situation with that of the electric lighting situation many years ago, when it was found that while a plant was paying perhaps 25 per cent. profit, it was constantly installing in new machinery and apparatus, and the stockholders got nothing, the reason being that the people who invested had not required a standardized equipment. He considered it would be a wise plan to disseminate information that people would know they could get a certain character of equipment and that equipment would enable them to connect with others who have perhaps a different equipment, but of the standard type, and this could be done without adopting the standard of any particular manufacturer. Secretary Coleman gave some illustrations of the evils of lack of standardization and insisted that something must be done along the lines of standardization. He made a motion that the matter be referred to a committee and a plan worked out so that standard apparatus can be used, which motion was seconded and unanimously carried.

Mr. H. D. Critchfield appeared before the convention at the request of Mr. Wheeler, president of the Illinois Telephone & Telegraph Company. Referring to the tunnel built by his company, he said that it was claimed that it is a freight proposition, but the truth is that it is not only a freight proposition, but is a telephone proposition, and a proposition which can be used for anything for which the street of the city could be legitimately used for the purpose of public utility. It is the purpose of the company to give toll connections when it can connect with the right sort of apparatus, and any company having a good exchange operating under proper conditions will stand on the same footing exactly as the company's own exchange. The company, however, will not give a toll connection until good toll service can be given, and it will not offer a toll line service until it can give such a service as will be satisfactory to users. The matter will be taken up in the spring of constructing some toll lines radiating from Chicago, not with a view to undertaking to handle the toll business of Illinois, Wisconsin or Indiana, but of making connections with the toll lines in those States to handle the business by trunk lines in a way that will afford the best possible service. The company will not compete in the territory for local business, but to bring that business into Chicago. This will not be taken up by the Illinois Telephone Company, but by another company not yet announced. In reply to a question, he said he considered it reasonable to suppose that a good entrance can be made into Chicago by next fall. In reply to another question, he said that the Illinois company had no affiliation with the Bell Company of any kind and that it will not sell a telephone or switchboard to any man who is using Bell apparatus; the company has had opportunities to do so and has refused.

At the morning session of Thursday, December 10, the Committee on Temporary Constitution submitted a draft of constitution, which was adopted after some amendments.

Mr. O. Rex, of North Manchester, Ind., read a paper entitled "Competition Between Independent Companies and Farmers' Mutuals," which led to considerable discussion. He deprecated the practice of manufacturers working up farmers' companies, and suggested that independent exchanges should take the lead, advising the farmers as to construction and equipment in order that no difficulty will be encountered with exchange connections.

The subject of competition from farmers' mutual telephone companies was discussed at considerable length and various means were proposed whereby harm from farmers' companies might be warded off. Complaint was made that notwithstanding the resolution adopted by the Association last year condemning manufacturers for working up farmers' companies, certain manufacturing concerns were still promoting these competing farmers' companies where independent companies already exist. The subject of exchange of business having been broached, Judge Taylor, of Indiana, mentioned a case where a judge had ruled that if a telephone company makes arrangements for an exchange business with one company it must exchange with any other company that makes the demand. The case is now

[1] See Electrical World and Engineer, Dec. 12, page 950.

on appeal. Mr. Zimmerman stated that in Kansas it had been considered that telephone companies had the right of public domain, but a recent decision by a Supreme Court judge was to the effect that the telephone companies have no right on the public highways except such as are gained from the farmers along whose lands their lines run. Mr. Rogers, of Indiana, argued in favor of the principle that the occupation of highways shall be decided by the voice of the people. Mr. Thompson said that in Ohio the right of eminent domain had been adjudged to telephone companies, but the companies must settle with persons who have land abutting upon the highway. Mr. Barnhart, of Indiana, said that his State Legislature had recently passed a bill in the interest of the independent telephone movement, whereby telephone lines could be constructed in towns and cities without the consent of the abutting property owner, but consent must first be obtained of the commissioners of public highways and of the town council; the consent of the owners of property is not, however, required.

Mr. Henry A. Barnhart, of Indiana, read a paper entitled, "Where Should the Line of Demarcation be Drawn Between Independent Operating and Manufacturing Companies and the Bell?" He considered that the independents should stand aloof from any compromise whatever with the Bell Company, but he counseled the evasion of fight unless absolutely necessary in self-defense or in clearing away for the forward march. As to manufacturing, if there is Bell capital in any so-called independent factories the Association should know it and protect its membership and independent telephone interests from this imposition so they might not contribute strength to a competitor. A condition of great concern for the independent telephone movement is long-distance connections. For instance, a half million independent telephones are in operation within a radius of 200 miles from Chicago, all serving territory within the immediate commercial environment of Chicago, but not a single one of them can get a connection with this most important business center. The influence which keeps the independents out of Chicago is costing its business millions of dollars in cases of rental and trade losses every year, and this all goes to Bell telephone profits. The same is true, moreover, of other cities. Following the paper of Mr. Barnhart, Mr. Prewitt presented a paper entitled, "What Should be the Voting Representation in the Conventions of the Interstate Independent Telephone Association?" He advised that the country should be divided into telephone districts and the organization in each of a district association, in which every independent telephone company should have a right to become a member. He recommended that each company send one representative, who, on all questions, should have a single vote; but on certain questions he should have a vote in proportion to the size of the company he represents. The members of the district associations should delegate to their association the power to control the sale of voting stock and to make contracts with all telephone companies not members of the association, and settle all questions arising between members of the district association, and such other powers as may be expedient. Every district association would become a member of the Interstate Association, which on certain predetermined questions would have a single vote, while on other questions he would have a vote commensurate with the size of the companies in the district association of which he is a delegate. Every district association delegate to the Interstate Association would have the power to revoke or annul the sale of any stock by one of its members or any contract it may make for any of its members with a company other than the district association, together with the power to settle all questions that may arise between district associations, or a member of one association with a member of another association and other powers that may be deemed expedient. He considered that his proposition embodied the great American idea—management of the owners by the owners for the owners.

Mr. J. S. Bailey, of Ohio, then addressed the convention and gave a review of the present situation of the Independent Telephone Association, with particular reference to large installations recently completed or now underway. He considered that by the time the convention meets next year the independent systems will have long-distance service for a greater distance than the Bell Company. The various independent long-distance companies already represent each one of them millions of dollars—some of them two or three millions—and the large companies which will come will represent probably forty or fifty million dollars. No small interest should be afraid of the effect of consolidation of long-distance systems when it comes, and all should welcome it as the one thing which adds more to the value financially and to the service of the independent telephone interests in the United States than any other one thing.

A resolution introduced by Mr. Brooks, of Minnesota, referring to Postmaster-General Payne, led to an animated discussion. The resolution was to the effect that the president should appoint a committee of three to investigate the action of the Postmaster-General relative to his ordering independent telephones out of post-offices. Mr. Brooks said that his resolution was suggested by the action of the Postmaster-General in ordering out an independent system in the post-office at St. Paul and ordering the Bell system to be used. Mr. Presson, of Iowa City, Iowa, said he was heartily in favor of the Association taking up the matter of the resolution with Washington, as it is very plain that Postmaster-General Payne is biased in favor of the Bell system. Mr. Rogers, of Iowa, also supported Mr. Brooks and made some severe reflections on the action of Postmaster-General Payne. Mr. R. C. Hall, of Pittsburg, said he considered that the matter should be brought to the attention of the President, and he thought it might result in the removal of Postmaster-General Payne. An amendment to the resolution that the report of the committee be sent direct to President Roosevelt was adopted. Another resolution was adopted directing that each member of the Association should write to the Congressman of his district and call his attention to the matter that had just been discussed, and that copies of the resolution be printed so that the members might have it to forward to the Congressmen.

Mr. W. H. McDonough, of New York, then read a paper on the telephone periodical press. He showed what service the journal which he edited had been to the independent interests through showing up the methods of the Bell Company. At the conclusion of Mr. McDonough's paper, Mr. Rogers, of Iowa, complained that it contained an attack upon him and said that he had laid a trap for the gentleman and had been informed that he would be attacked at this meeting for that reason.

Electrical Production in Germany.

Mr. Simon W. Hanauer, Deputy United States Consul at Frankfort, sends the following with regard to electrical production in Germany: "An essay on the electrotechnical industry of Germany, written by Dr. Brüner, the syndic of the Association for Fostering the Interests of German Electrotechnics, gives the following data: 'Germany's output of the electrotechnical products during the year 1898 aggregated 228,670,000 marks ($54,423,460) in value, of which 57,000,000 marks ($13,566,000) was for foreign orders. The value of the exports of electrotechnical products rose to nearly 100,000,000 marks ($23,800,000) in 1902, although the total production decreased considerably in that year. The total amount of capital invested in German electrotechnical works and enterprises in 1900 amounted to 2,500,000,000 marks ($595,000,000). The greater part of this colossal sum has since been wiped out by the terrible depreciation of the share capital. Many of the enterprises inaugurated and conducted for their own account by the electric manufacturing companies proved unprofitable and had to be given up, nearly all the capital invested becoming a dead loss. Among these ventures electric railroads in mountain districts and tramways and lighting plants in the smaller towns form a large proportion of the losses.'

"Dr. Brüner discusses at length the errors committed by the electrotechnical companies and urges them to center their energy upon obtaining orders abroad.

"The *Electrotechnical Journal* says that the increase of electric roads in Germany during 1902 was about 300 km. (186 miles), with an additional 400 km. (248 miles), in course of construction. The number of motor cars is estimated at 12,500, against 7,300 in 1901."

British in Thibet.

A British expedition has, after a long march, invaded the ancient and mysterious land of Thibet, but has not found the Central Asians particularly polite or cordial, although the desire is to promote trade relations with them. The Thibetans strongly objected to the telegraph line which the expedition laid as it advanced, and it is believed that they made an attempt to destroy it.

Ohio Independent Telephone Traffic Association.

A meeting of the directors of the Independent Telephone Traffic Company, of Cleveland, was held in Columbus recently for the purpose of discussing, besides other matters, the advisability of moving the headquarters of the company from Cleveland to Columbus. The Traffic Company was formed about a year ago for the purpose of bringing about a number of improvements in the management of independent telephone exchanges in Ohio. Thus far its efforts have been confined chiefly to buying supplies of all kinds and distributing them to the 70 or more companies who are members of the association. It was finally decided to allow the headquarters to remain in Cleveland for the present at least. A meeting will be held in Cincinnati the second week in February for the purpose of organizing a broader association somewhat on the order of the now defunct Ohio Independent Telephone Association. The independent interests of Ohio are much interested in the movement to establish an independent company in Cincinnati, and the meeting held in Cincinnati will also be for the purpose of helping along that movement. It will be the aim to bring all the independent companies in the State into the association.

The Year's Patent Record.

The Secretary of the Interior, Mr. Hitchcock, in his annual report just published, says:

"The record of the Patent Office shows that there were 49,199 applications for letters patent, 801 applications for designs, 156 applications for reissues, 1,767 caveats, 2,530 applications for trade marks, 1,208 applications for labels, and 362 applications for prints. There were 29,892 patents granted, including reissues and designs, and 2,194 trade marks, 910 labels and 233 prints were registered. Twenty-three thousand three hundred and ninety patents expired. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 4,760. The total receipts were $1,591,251.04, the expenditures being $1,423,094.40. The commissioner shows that the business is growing, there being an increase of about 32 per cent.

Attention is called to the amendment of March 3, 1903, to Sections 4887, 4892, 4896 and 4902 of the Revised Statutes. This gives effect to the International Convention for the Protection of Industrial Property, and extends the period within which an application for a patent could be filed in this country, after an application abroad, from seven to ten months; requires the authority of foreign officers administering oaths to applicants for patents to be proved by a certificate of a diplomatic or consular officer of the United States; permits a foreign administrator of a deceased foreign inventor to file an application in this country, upon the authority of such foreign administrator being proved by a certificate of a diplomatic or consular officer of the United States, and prevents foreigners, as well as citizens of this country from filing caveats.

CURRENT NEWS AND NOTES.

CHEAPER RADIUM.—Professor Himstedt, of Freiburg University, Germany, states that he has made the interesting discovery that all the products of water and petroleum sources yield a heavy specific gas closely resembling and probably identical with the emanation of radium, whence he concludes that a very large number of bodies possess the quality of emitting a kind of Becquerel rays.

MUNICIPAL SHORTAGE IN CHICAGO.—An apparent shortage of $5,000,000 in the Special Assessment Bureau of the municipal government is reported by Haskins & Sells, expert accountants, engaged to audit the books. With the statement are charges of misappropriation of funds and of criminal management during the last thirty-two years. It is alleged that much of this reported shortage, which should have gone to taxpayers of Chicago in rebates for improvements, has been illegally transferred during former years to the credit of other municipal governmental departments which had exhausted their appropriations and wanted to make a good showing. It is also stated that a sum in the millions has been stolen.

N. E. L. A. REPORT ON STEAM TURBINES.—The National Electric Light Association's committee for investigating steam turbines, of which Mr. William C. L. Eglin, of Philadelphia, is chairman, has already accumulated a large amount of very valuable data on steam turbines, and will publish in its report a full description of the turbines manufactured in this country, and also expressions of opinion from some of the leading European engineers concerning the use of the steam turbine and the field it occupies in Europe. This report will be quite voluminous, and will undoubtedly give more interesting information than has yet been published. It is the expectation of the committee that this report will be in the form of a bound volume prepared for distribution to members at the twenty-seventh convention, to be held in Boston in May.

TELEPHONE-PHONOGRAPH.—A cable dispatch from London of December 14 says: "The *Daily Mail* announces that it has conducted reasonably successful experiments with a recording telephone, called the electrograph, which is the invention of E. G. Craven, an English engineer, who was once an assistant of Thomas A. Edison, at Menlo Park, N. J. The mechanism combines a telephone and phonograph. Messages spoken into the telephone transmitter were sent over a dozen miles between London and Twickenham, where they were received by the phonograph, without audible sound, by direct electrical effect on a vibrating diaphragm. When the phonograph was disconnected from the telephone wire and reversed the messages were reproduced audibly and distinctly. Mr. Craven declares that his invention will be the greatest addition to the conveniences of business since the invention of the telephone a generation ago, as the electrograph leaves a permanent record of conversations." This was all done successfully years ago by Mr. W. J. Hammer, between New York and Philadelphia. He was awarded a medal for it by the Franklin Institute. Let us have something really new

SECRETARY SHAW AND THE METRIC SYSTEM.—In his annual report the Secretary of the Treasury very strongly urges the adoption of the metric system. The report states that during the year the attention of the department has been forcibly called to the growing need for international uniformity in so fundamental a necessity to trade as weights and measures. The Customs Congress of American Republics, held at New York, strongly urged the adoption of the metric system to simplify the transaction of government business in connection with international trade. Moreover, the National Board of Trade of the United States, the Board of Trade of Canada and the Congress of Chambers of Commerce of the British Empire have recently urged by strong resolutions the adoption of the metric system. In conclusion Secretary Shaw says that the experience of forty countries of the world has proved beyond question that the international metric system is unsurpassed for practical convenience, possessing as it does a terminology concise, definite and free from ambiguity, affording a maximum facility in the countless transactions and computations of science, manufacture and commerce.

REPORTING ACCIDENT BY WIRELESS TELEGRAPH.—The steamship *Kroonland,* of the Red Star Line, from Antwerp, December 5, for New York, which sent a wireless telegraph message saying that her steam tiller was broken and that she was returning to Queenstown, steering with her engines, arrived there at 8.30 A.M. on the 9th. She was attended by a tug, which had been sent in response to her wireless message. The saloon passengers, on landing, were enthusiastic over the utility of the Marconi wireless telegraph system, by means of which news of the accident was received. The break-down of the steering apparatus occurred when the *Kroonland* was 130 miles west of Fastnet. Captain Doxrud immediately sent a wireless message to Crookhaven for the agents of the line in Antwerp, describing the damage and informing them that the steamer must abandon her voyage. A reply was received within an hour and a half, whereupon Captain Doxrud complied with the instructions sent him to return to Queenstown. Meanwhile, three-fourths of the saloon passengers and a number of those in the second cabin sent wireless messages to friends in various parts of Great Britain and Europe, and many of them received replies before Fastnet was sighted from the steamer. Some of the wireless messages were cabled to the United States. In some cases the senders asked friends for money, and the replies authorized the purser to advance funds to them, which was done before land was sighted.

RADIUM AND CANCER.—The London papers are discussing radium cures of cancer. Eleven cases are under treatment at the Cancer Hospital, but the medical authorities are very cautious and slow about announcing cures or changes, except in surface cancers.

FIRST ELECTRIC SLEEPING CAR.—A special telegram from Wilmington, Del., states that the Harlan & Hollingsworth Company has completed the electric sleeping car, Theodor, and has shipped it to Indianapolis. The car was built for the Holland Car Company, of Indianapolis, and is the first electric sleeping car constructed.

ROYAL ELECTRIC LIGHT BATHS.—King Edward is reported from London to be taking electric light baths. "These are installed at Windsor Castle and at Buckingham Palace. One has a projector of 2,500 cp for use in local affections of the body. Inside the other bath, in which a sitting posture is adopted, there are fifty-two incandescent lamps, which radiate any colored light desired."

A NEW INCANDESCENT LAMP.—A new type of incandescent lamp filament has recently been perfected by Dr. Just, of Vienna, the essential feature of which is the use of bornitrate $B(NO)_3$ as material for the filament. The lamp gives a light similar to that of the ordinary filament, and tests have shown an average life of 300-400 hours. It is stated that the cost of manufacture is not greater than that of the ordinary lamps. Up to the present only lamps of 50 and 100 volts and 35 cp have been produced. The most important feature of the lamp is its high efficiency, it being stated that the lamp operates satisfactorily at 1.9 watts per candle-power.

LIGHTING WESTMINSTER ABBEY.—A cable dispatch from London of December 12 says: "Westminster Abbey is to undergo something tantamount to a revolution. The historic Pyx Chapel, the massive door of which is a familiar feature in what are popularly known as the dark cloisters, is about to be lighted by electricity and thrown open for inspection. Public entrance to the chapel was no easy matter, for no fewer than seven keys were necessary before the two oaken doors would swing open. It was in this chapel, one of whose doors was upholstered in human skin, that in days gone by were stored government standards and assays of gold. Among the other contents of the place are a curious stone altar and some ancient chests, in which State documents, exchequer tally sticks and other things were deposited."

RADIUM TEAS FASHIONABLE.—In London radium afternoon teas and parties are quite the fashionable thing, and the Crookes spinthariscope has gained popularity as a Christmas present. The supply ran short, however, perhaps fortunately, because there have been several cases where the spinthariscope has been the cause of certain troubles to which inexpert handling of radium frequently gives rise. The announcement made of the lethal effects upon rabbits obtained by Dr. Heincke, of Leipsic, by exposing them to the action of Röntgen and radium rays, gave warning that those desirous of treatment by new methods should be careful in their choice of practitioners, and their handling of scientific apparatus. He showed that systematic exposure to X-rays, already known to be harmful to the skin, is also very damaging to the internal organs, especially the spleen and brain, resulting in death after emaciation, fear, languor and prostration.

TELEGRAPHY IN HONDURAS.—An official report from the Republic of Honduras says with regard to means of communication: "Telegraph lines have been hung in every department (province) and all the principal towns are connected with each other and the capital telegraphically. The system is under government control, and during part of the day the wires are open only to official messages. There are 180 offices and over 600 persons are employed in this branch of the service. The system comprehends about 3,250 miles of lines. The revenue of the telegraph office amounted in 1901-2 to 54,455.40 pesos. Government messages are carried without charge. Cable messages produced a revenue of 24,837 pesos from a transmission of 10,951 words. Telephone service is established in Tegucigalpa, but will require considerable attention to produce efficacy. Eight new offices were opened during the year, but the system in general has not been improved or extended. Telegram blanks of the value of 15, 30, 45, 60, etc., centavos are sold in all the stores, and upon them may be written five words for each 15 centavos of value. These telegrams may then be placed in any telegraph office for transmittal without further charge."

ELECTRIC LIGHTING IN CLEVELAND.—The Cleveland authorities seem to be possessed with the Socialistic idea. Just recently the voters of that city decided positively against the proposition to establish a municipal electric lighting plant. Thus defeated, other means of working injustice upon existing private companies are to be tried, it seems. The city solicitor of Cleveland is preparing an ordinance fixing the price of electricity for illuminating purposes in the city. The city officials claim that the new municipal code for Ohio cities authorizes municipalities to fix the price of electricity distributed by companies holding franchises on streets. It is probable that the ordinance will fix the price of city arc lamps at $70 per year, instead of $75 as paid under the present contract with the Cleveland Electric Illuminating Company, and the price of current for private consumers will be reduced from 12 cents, the present scale, to 7 cents per kw-hour. The attempt to enforce such an ordinance will probably result in law suits.

NOBEL PRIZES.—The Norwegian Parliament has awarded the annual Nobel Peace Prize of $39,150 to William R. Cremer, M.P., publisher of *The Arbitrator,* of London, for his work on behalf of international arbitration. The prize for physics is divided between Henri Becquerel and M. and Mme. Curie. The chemical prize goes to the Swedish Prof. Arrhenius, the medical prize to Dr. Finsen, of Denmark, and the prize for literature to Björnstjerne Björnson, the Norwegian poet and dramatist. These prizes amount to about $40,000 each. The formal distribution of the prizes took place last week in the presence of the King and several members of the royal family. His Majesty presented the prizes, each of which was accompanied by a diploma and a gold medal, to Henry Becquerel, Prof. Arrhenius, and M. Björnson. Dr. Finsen and M. and Mme. Curie were absent, but were represented by the Danish and French Ministers.

STEAM TURBINE TESTS.—The opinion of members of both the Senate and House Naval Affairs Committees is believed to be favorable to an appropriation of $25,000 for experiments by the Navy Department with steam turbine engines. This appropriation has been asked for by Rear Admiral C. W. Rae, chief of the Bureau of Steam Engineering, who believes that at least two small ships of the navy should be fitted with this type of propulsive machinery for experimental purposes. Rear Admiral Melville, retired, who was Rear Admiral Rae's predecessor, made a recommendation to this effect. A board, of which Commander John R. Edwards and Alfred B. Canaga were members, filed recently a report of an inspection they made of the turbine yacht *Revolution,* equipped with the Curtis turbine. They found this yacht very fast, especially for short distances. They made careful observation of her general features and of the engine installation. While the performance of the craft was creditable for her class, they reported that there was no means of telling how expensive her engine might be in steam consumption or how effective it might be. The board favors the installation of steam turbine machinery in some type of naval vessel. The Bureau of Steam Engineering and the Bureau of Construction and Repair are and have been for several months, conferring as to the best methods of installation of machinery and the best type of hull for a turbine-propelled scout ship or cruiser, should one be authorized. England is already equipping some ships in her navy with the turbine.

LETTER TO THE EDITORS.

Heating Handles of Automobiles and Cars.

To the Editors of Electrical World and Engineer:

SIRS:—I was much gratified to observe in your issue of December 5 a short description of an electrically-heated handle, a patent for which was recently granted to me. I am pleased to know that the invention has attracted your attention. You have evidently experienced the great discomfort that, heretofore, has been inevitable from cold hands while operating automobiles in winter weather.

If I remember correctly, you say in the last line of your paragraph, "A small supply of current suffices to keep the fingers comfortably warm." I think you will be surprised when I tell you the

results of a test I made recently in very cold weather with one of my handles attached to the steering lever of an electric automobile. The temperature during the test was considerably below freezing and a high wind was blowing—a combination guaranteed to numb the fingers and hands of the most hardy motorist in a very short time. After numerous experiments, I found that a consumption of energy at the rate of 9 watts would keep the handle as warm as I could desire it even on such a cold day. This is practically a negligible quantity of energy to consume, especially when one considers the very great comfort that such a small amount of energy affords.

As you know, one seldom wishes to operate a machine for five hours at a stretch. Assuming such a contingency, however, the amount of energy that would be required to keep the hands perfectly warm, even in extremely cold weather would only be 45 watt-hours. Allowing for such losses as occur in charging storage batteries, the actual expense for five hours of solid comfort, charging for current at the rate of 10 cents a kilowatt-hour, would amount to the huge sum of .64 of a cent. Of course, the handle can be used to great advantage on the handles of trolley cars, bicycles, steering wheels of yachts, ships, etc., as well as on the steering wheels and controlling levers of automobiles.

NEW YORK CITY. R. A. FLIESS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Traction Motor.—SZASZ.—An article in which he refers to an opinion recently expressed by Niethammer that in view of the success of the Winter-Eichberg single-phase motor, the competition will be in future no longer between direct-current and three-phase current, but rather between direct current and single-phase for traction purposes. The present author thinks that this opinion is not justified by the information published on the Winter and Eichberg motor, and he compares their single-phase motor with the three-phase motor, to show that the latter is superior in efficiency. He first analyzes some curves showing the behavior of the single-phase motor (these being the same curves printed in another connection elsewhere in this issue). These curves show that when the power varies (either on account of variation of speed or of torque), there is a certain transformation ratio for the regulation transformer for which the efficiency and the power factor are a maximum. When the torque changes, the speed also changes when the same transformation ratio is maintained, but by varying the ratio of transformation it is possible to maintain the speed more or less constant. For a constant ratio of transformation the behavior of the Winter-Eichberg single-phase motor is somewhat similar to that of a direct-current series motor as far as the variation of torque and speed are concerned. But on account of the very rapid slope of the efficiency curve from its maximum point, the motor must be operated at a certain ratio of transformation within relatively small limits in order to insure good efficiency. If a road should have many and rapidly-changing grades it will be necessary to regulate the ratio of transformation continually with great care. This is not required for direct-current nor for three-phase current traction. The single-phase motor is peculiar in so far as for the different ratios of transformation the maximum efficiency is obtained at nearly the same speed. From the diagrams the author finds that this speed is 32, 32, 32, 31.5, 36, 38 km. for six different ratios of transformation varying between 24 to 1 and 8.3 to 1. The corresponding values of the torque are 450, 570, 725, 825, 830 and 890 kg., respectively. The most economical speed is, therefore, nearly constant, though increasing somewhat for the greater values of torque. Any deviation from the most economical speed produces a decrease of efficiency. According to the ratio of transformation, differences from the most economical speed up to about ± 20 per cent. can be obtained if one does not care to decrease the efficiency by 5 per cent. In this respect the Winter-Eichberg single-phase motor is different from the direct-current series motor. First, the efficiency of the latter is good for all speeds, and, secondly, the tendency toward maintaining uniform power with varying torque is lacking in the single-phase motor. In fact, the latter has the reverse tendency, since wherever torque and speed change together, they increase simultaneously. The author then compares the economy of a pair of two single-phase motors with that of a pair of equivalent three-phase motors. For the single-phase motor he assumes a continuous adjustment of the ratio of transformation. The comparison is also made for half the normal speed, which corresponds to the tandem connection of the three-phase motors. From his curves it appears that at the most economical speed the single-phase motor operates with a higher power factor, but a smaller efficiency than the three-phase motor. For half speed both power factor and efficiency are better for the three-phase motor. For the consumption of current the product of efficiency and power factor is of decisive importance, and this product throughout is better for the three-phase than for the single-phase motor, and the difference is even greater in the case of half speed. The efficiency of the Winter-Eichberg system is in the most favorable cases about 83 to 87 per cent., while it is 93.5 per cent. for the three-phase motor, and this value is maintained over a wide range. The losses in the motor have, therefore, in the single-phase motor, about double the value of the losses in the three-phase motor; the single-phase motor, therefore, must have considerably larger dimensions in order to give off the developed heat. The author concludes that these conditions render the value of the regulation of the Winter-Eichberg single-phase system without resistances quite doubtful. As far as can be judged from the published diagrams of the motor, the starting is less economical and the energy losses in motor and transformer are greater than with the three-phase system.—*Zeit. f. Elek.*, November 22.

Testing of Generators by Air Calorimetry.—TEELFALL.—A long, illustrated paper read before the (British) Institution of Electrical Engineers on a method of determining the efficiency of generators in cases in which the ordinary methods are unsuitable. He encloses the generator in a non-conducting casing and pumps air through the system at a measured rate. The arrangements are so made that no heat is lost by radiation. If, then, means are available for the rapid and accurate measurement of the current of air, it is only necessary to ascertain the temperature of the air on entering and leaving the system in order to find the heat developed in the generator. The efficiency is then given by the ratio of the electrical energy developed by the generator divided by the sum of the same electrical energy plus the heat developed in the same time. The main difficulty is in measuring the air current, and the devices for this purpose are described at great length. The author points out that his method shares with the well-known Hopkinson test the advantage that the power lost is the direct subject of measurement, and a considerable error may be made in this estimation without proportionately effecting the result for the efficiency, as long as machines of high efficiency are in question. For instance, if a 100-kw machine under full load is being investigated and the measured loss is 10 kw, then the resulting efficiency is $100 \div 110 = 90.91$ per cent. If there should be an error in the determination of the loss amounting to 10 per cent., so that instead of 10 kw it is really only 9 kw, the efficiency of the generator would be really $100 \div 109 = 91.74$ per cent., and the error of the estimate would be $91.74 - 90.91 = 0.83$. Hence, an error of 10 per cent. in the measurement of the loss corresponds to an error of less than 1 per cent. in the efficiency figure.—Lond. *Elec.*, November 27.

REFERENCES.

Single-Phase Motor.—A reprint with illustrations of a British patent applied for by Winter and Eichberg on October 24, 1902, the complete specification being accepted exactly twelve months later. An abstract of the patent will be found on another page of this issue. —Lond. *Elec.*, November 27.

Single-Phase Motors with Commutator.—BLONDEL.—The first part of what appears to be a serial on this subject. He first describes the various single-phase motors devised before 1900 and then gives a mathematical theory of the series motor. The article is profusely

illustrated by diagrams and is mainly mathematical.—*L'Eclairage Elec.*, November 28.

Induction Motor Diagram.—THOMALLEN.—An article in which the author says that while the Heyland diagram of the induction motor is simple, that of Ossanna is more exact, but the calculations based upon it are much longer. The author describes a graphical method which he believes to be suitable for application to small motors. The article consists mainly of diagrams and formulas.—*Elek. Zeit.*, November 26.

LIGHTS AND LIGHTING.

Stage Lighting.—An illustrated description of the lighting installation of the new Gaiety Theatre in London. Current is obtained from three distinct sources, two of which are interchangeable. The total number of lamps in the building is 4,703, exclusive of arcs, for which 240 amp. are required. The stage switchboard is provided on its extreme right hand with four main switches fitted with carbon breaks. They control, respectively, the auditorium lights, and white, red and blue lamps on the stage. At the top of the board are three pilot lamps, which indicate whether switches on smaller boards situated in other parts of the building, are open or closed. All lights on the stage, as well as the majority of those in the auditorium, are controlled by the stage board. Only one of the two wires is taken through the stage board, the return being connected through fuses to a separate distribution board. Hence, it is impossible to get a short circuit on the board itself, as it only controls one pole. In connection with stage lighting, it is frequently necessary to put out every light with the exception of a few in the float or a particular batten. This constituted a difficulty hitherto and has usually been effected by switching off individual circuits separately. In the Gaiety Theatre this difficulty has been overcome in the following manner: In series with each circuit switch is a two-way switch, one pole of which is connected to the ordinary bus-bar controlled by the main switch, the other pole being connected to a bus-bar attached to the live side of the main switch. Hence, it is possible to make any circuit fitted with this device independent of the main switch. The whole board controls 3,000 lamps and has a capacity of 1,000 amp. As

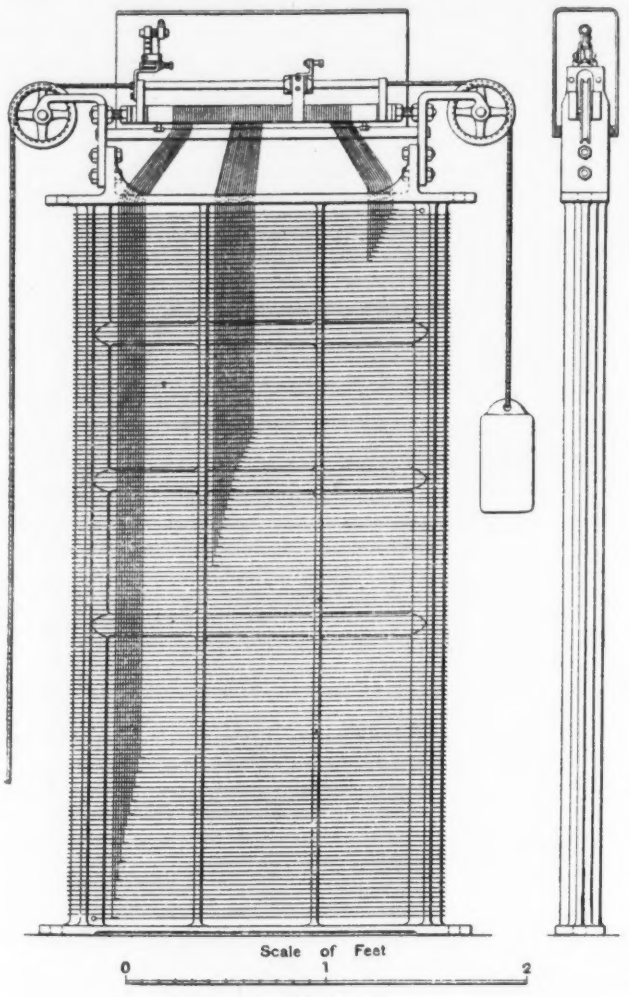


FIG. I.

regulating devices, 24 liquid resistances and 33 wire resistances, the latter wound on asbestos-covered iron frames, are used. One of the wire rheostats is shown in Fig. 1, from which it will be seen that connections are taken from the winding at various positions and attached to contacts at the top. These contacts when built up form a solid bar of alternate slices of copper and insulation, which presents the appearance of a developed commutator. Along the bar runs a rubbing "jockey," which is worked to and fro by the regulator lever and a counter-weight. A device is provided to prevent damage to the last contact by sparking. Before the jockey gets to the end of the bar it causes the circuit to be broken through a tiny spring switch with carbon contacts. This switch closes again automatically when the jockey is drawn back by the counter-weight.—Lond. *Elec.*, October 30.

POWER.

Motors for Power Presses.—FLADD.—An article in which the author gives a long list of commercial power presses, together with the horse-power of electric motor required to drive it. Concerning the connection of motor and press, he is inclined to slightly favor the belt drive, as it gives a little elasticity between the motor and the press, when a quick, heavy load is suddenly thrown upon it, as in the case of press punching and stamping. The large coining presses used by the United States Mint in Philadelphia for striking up silver dollars exert a pressure of 160 tons and run at a speed of 80 per minute, with a 7½-hp motor. The smaller size press for coining the quarter dollar pieces, which runs at a speed of 100 per minute and gives a pressure of 60 tons, is driven by a 3-hp motor; a double-feed roll blanking press at a speed of 90 per minute requires a 3-hp motor; a double-cut-off shear, 3 hp; the 10 x 9-in. rolling mills are driven by a 50-hp motor and the coin upsetting machine by a 3-hp motor. This mint machinery is of special design. Some factory managers think it better economy to run their power presses in groups, driving from one motor a main line.—*Iron Age*, November 26.

TRACTION.

Repair Shop.—A fully-illustrated description of the repair shops of the St. Louis Transit Company. By means of an electric hoist a car can be raised and the truck run out; twenty-four tracks are equipped with hoists of this kind. All new cars are built with motors which open from above, so that examination from the pit is not required. An electric transfer table is used which takes its power from an overhead wire. Some of the special machines used in the winding department are illustrated, and also the apparatus for testing the insulation of armatures by means of transformers. The operator holds in his hand a small piece of light sheet iron, which will vibrate in case there is a short-circuit.—*St. R'y Jour.*, November 14.

Paris.—GUERY.—The first part of a profusely-illustrated article on the electric installation of the road Les Invalides à Versailles. He first gives the history of the electric installation of this line on which the third rail is used with 500 volts direct current. For transmission, three-phase currents at 5,000 volts are used and converter substations are installed along the line. The equipment of the main power house is described in detail. It contains nine generators each of 800 kw and four direct-current exciters.—*L'Eclairage Elec.*, November 28.

Single-Phase Traction.—See the abstract and reference under "Dynamos, etc."

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Installations in an Asylum.—An illustrated description of the Portrane Asylum, which is the largest private lighting and power installation in Ireland. Power is generated by three 80-kw, 250-volt dynamos. There is provided a storage battery sufficient to provide current for 1,000 lamps of 8 cp for three hours. A motor-driven booster serves to charge the battery. Numerous motors are distributed over the buildings. There is also a telephone system and a fire alarm system installed.—Lond. *Elec.*, October 30.

WIRES, WIRING AND CONDUITS.

Wiring.—RAWLINGS.—An abstract of a paper read before the London Contractors' Association, in which the author proposes a model specification for electric wiring and fittings. His object is to arrive at a standard specification carrying with it general conditions to be known as the National Electric Contractors' Association

conditions of contract, in order to avoid a repetition of words in drawing up a specification. This model specification is printed in full. It relates to the various forms of wiring in use, but does not include concentric.—Lond. *Elec.*, November 6.

Electro-Physics and Magnetism.

Positive Ions.—Townsend.—An account of a theory of the genesis of ions by positive ions, and its application to experiments with air and hydrogen. The theory is founded on the determination of the conductivity produced between parallel plate electrodes when ultra-violet light falls on the negative plate. The potential required to produce a continuous discharge may be found by his theory on the assumption that all the ionization is produced by the collisions of positive and negative ions with neutral molecules in a uniform field of force. There is a very good agreement between the potentials thus calculated and the sparking potentials determined experimentally. It requires much larger forces to develop new ions by the motion of positive ions in air than in hydrogen.—From *Phil. Mag.*, November; in Lond. *Elec.*, November 13.

Spinthariscopic Phenomena.—Becquerel.—An account of an investigation in which he studied the phenomenon observed by Crookes in order to determine to what kind of radium rays it is due, and what physical process the scintillations represent. For the screens he used the hexagonal zinc blende or diamond dust. In a strong magnetic field the rays producing the scintillations were not deflected. This confirms Crookes' supposition that the rays producing the sparks consist of positive electrons. As regards the nature of the scintillations, they are in general the more pronounced and vivid the smaller the crystals are which compose the screens. The sparks are most likely due to cleavages taking place in the crystal, and not to the mere impact of the positive ions. There exists here an analogy with the scintillations observed on breaking a piece of sugar.—From *Comptes Rendus*, October 27.

Charge by Ion Absorption.—Simpson.—The permanent negative charge on the earth's surface is due, according to Elster and Geitel, to a charging of the surface through absorption of ions from the surrounding atmosphere. The present author points out that this theory rests upon an experiment by Zeleny, which had a different result when repeated by Villari. The present author has made a series of experiments to find the conditions under which a conductor can become charged, and to what extent in consequence of ionic absorption. Zeleny's results are best accounted for by ascribing a higher rate of diffusion to the negative ions.—From *Phil. Mag.*, November; Lond. *Elec.*, November 13.

Influence of Electrodes on Colloidal Solutions.—Hardy.—A description of an effect of radium rays in producing a colloidal substance. Specially purified globulin from blood was dissolved first in a trace of acetic acid and secondly in a trace of sodium hydrate. In acid the globulin moves in an electric field from the anode to the cathode, while in alkali it moves from the cathode to the anode. In the former case the globulin particles are, therefore, assumed to carry a positive charge and in the latter case a negative charge. These two solutions were exposed to the radiations from radium bromide, and it was found that the electronegative solution of globulin was turned into an opaque jelly in three minutes, while the electropositive solution became more mobile and less opalescent.—From *Proc. Camb. Phil. Soc.*, October 21; in Lond. *Elec.*, November 13.

Magnetic Storm.—A full account of the effects observed in Europe during the recent magnetic storm, together with an editorial discussion of the subject. The connection between sun spots, magnetic storms and intense earth currents is now practically beyond dispute, since they are always observed simultaneously, but the first cause of these phenomena is still to be sought. At present the hypothesis of Fitz Gerald and Lodge seems to be the most easily acceptable. The magnetic storms are considered to be due to the actual projection from the sun of minute particles in enormous number flying past the earth at great speed. The fact now accepted that radio-active elements emit charged particles at excessively high velocities, makes it easy to reconcile these views with the present position of physical theory. Moreover, as Arrhenius has pointed out, the aurora borealis which usually accompanies the phenomena of sun spots and magnetic storms may be explained under the same hypothesis, for the flying electrons would be deflected in the earth's magnetic field and carried towards the poles. During the recent magnetic storm the short telegraph lines were more effected than the long ones. While traffic on the long cables of the cable companies was only affected to a slight degree, inland telegraphic communication in England and France was completely disorganized. The reason is two-fold. First, the majority of the submarine cable companies use the syphon recorder, while on land lines and on the shorter cables the Morse system, working through relay is employed. Secondly, the interpolation of condensers between the cables and instruments shuts off the steady part of the current. As a result the British post office lines were troubled with 60 milliamp., which held over their relays and rendered signalling impossible, while the syphon recorders at the ends of the cables at Porthcurnow were recording perfectly legible messages just as usual, the only effect noticeable on the records being a displacement of the zero. Few measurements were made of the intensity of the earth currents. An actual electrometer test on a new section of Atlantic cable about 1,900 miles in length, showed a maximum measured potential difference between the conductor and sheathing of 31 volts, while the range of variation of pressure was something like 60 volts. In other cases voltages of over 300 have been observed during magnetic storms.—Lond. *Elec.*, November 6.

References.

Water Radioactivity.—Adams.—An account of an investigation of the nature of the radioactive gas found in Cambridge tap water by J. J. Thomson. It possesses properties remarkably similar to the emanation of radium. The value obtained for the rate of decay is in sufficiently good agreement with that of radium emanation to make it very probable that the radioactivity of the gas is actually due to radium emanation. Contrary to the opinion of Rutherford, he succeeded in showing conclusively that a small amount of radium emanation can be absorbed by water.—From *Phil. Mag.*, November; Lond. *Elec.*, November 13.

Magnetism of Basalt.—Allan.—An abstract of a (London) Physical Society paper on the magnetism of basalt and the magnetic behavior of basaltic bars when heated in air. The results are given of an experimental investigation in which bars were cut from English and German basalt and were tested by means of a magneto metric method to determine their magnetic properties at temperatures from 15 to 800° C.—Lond. *Elec.*, November 6.

Electro-Chemistry and Batteries.

Sodium.—Letheule.—An illustrated article on the sodium industry in France. The electrolytic process of Becker is first described, the electrolyte being a mixture of caustic soda and carbonate of sodium. A special device is used for collecting the deposited sodium at the top. The construction is described in detail and illustrated. In the second part of the article the electric process of Becker for the manufacture of chromium, manganese and sodium is discussed. By heating in an electric distillation furnace, sodium chromate and carbon, one obtains sodium which distills off and is collected in a condenser, and chromium of excellent quality which is tapped from the furnace. By treating mixtures of salts, or mixtures of salts and oxides, it is possible to produce alloys. By heating, for instance, sodium chromate and sodium aluminate with a sufficient quantity of reducing agent, an alloy of chromium and aluminum is obtained which remains in the furnace, while sodium distills off. Sodium has recently been applied to the refining of iron and other metals.—*Electrochemical Ind.*, December.

References.

Electric Steel Furnace.—Perkins.—A description of the Kjellin electric furnace at Gysinge, Sweden, for the manufacture of steel. The furnace is based on the induction principle, as has already been noted in the Digest. The present article gives detail drawings of the design of the furnace and data on the cost of operation.—*Electrochemical Ind.*, December.

International Congress for Applied Chemistry.—Danneel and Clement.—A very full account of the proceedings of the electrochemical section of the Berlin Congress for Applied Chemistry with concise abstracts of all the papers read.—*Electrochemical Ind.*, September, October, November, December.

Units, Measurements and Instruments.

Electrical Units at the St. Louis Congress.—An editorial discussing the programme of the International Electrical Congress to be held next year in St. Louis. It is said that while the Paris congress, in 1900, adopted the names of maxwell and gauss for units, yet in the technical literature of Europe they are not yet used at all, and in

the American technical journals only to a comparatively small extent. The reason is thought to be that the business man does not need names for the magnetic units, while he needs them for the electrical units when he orders a machine or charges for current, etc. Nevertheless, technical men should appreciate these names for the magnetic units on account of their brevity, since it is much easier to write 6,000 gausses than 6,000 C.G.S. lines of force per square centimeter. For this reason the suggestion to adopt in St. Louis the names of gilbert and oersted for the units of magnetomotive force and reluctance, will probably not find any opposition, especially since the proposition is made from the United States, and the two names to be honored are English and Danish scientists. It might, perhaps, be different with the two propositions made by the American Institute of Electrical Engineers and embodied in the two Institute papers of Carhart and Kennelly concerning the legalized standard of e.m.f. and the introduction of ames for c.g.s. (abvolt, abstatvolt, etc.). The editor urges that these propositions should be thoroughly discussed in advance of the congress, and opens the correspondence columns of his journal to such discussions.—*Elek. Zeit.*, November 26.

Electric Pyrometer.—An illustrated description of a pyrometer made by a British firm. It consists of a coil of platinum wire wound upon a cylinder of refractory material and usually fixed at the end of a long closed iron tube, where it is protracted by a platinum shield for measuring the resistances of the coil in order to ascertain the temperature. Two different arrangements are used. One comprises a differential galvanometer and a set of resistance coils and gives readings in ohms, and the temperatures corresponding thereto are ascertained by means of special tables. The second arrangement,

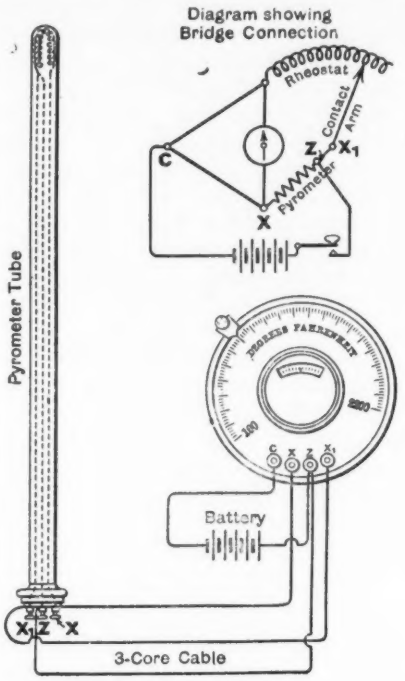


FIG. 2.—ELECTRIC PYROMETER.

which is shown in Fig. 2, is a combination of a simple d'Arsonval galvanometer and a Wheatstone bridge with a circular resistance and sliding contact, and it gives readings directly in thermometric degrees. It is claimed that both types give very accurate readings. Their principal field of application lies with iron, steel and similar processes, the temperature of which has to be constantly watched and regulated. In the instrument of the first type described above a change of the resistance from 10 ohms to 44.9 ohms corresponds to a rise in temperature from 58° F. to 2204° F.—Lond. *Elec.*, November 6.

Compensation Apparatus.—FRANKE.—An illustrated description of forms of compensation apparatus which enable one to measure e.m.f's with great ease within a very wide range, and which are intended to be used not only in the laboratory, but for tests of switchboard instruments, etc. The apparatus in its simplest form is shown in Fig. 3. The resistance wire, *A B*, over a scale with 100 divisions, is connected in series with the rheostat, *C D* (the resistance of which is 14 times that of *A B*), and an adjustable resistance, *R*, and a single storage cell, *H*, with an e.m.f. of about 2 volts. A standard cell, *N*, with a galvanometer in series, is connected by means of the sliding contacts, K_1, and K_2, to two points of the two resistance, *A B* and *C D*. These two points are so chosen that their numerical values correspond to the e.m.f. of the standard cell; for instance, 1.0192 volt for the Weston cell. If, now, the regulating resistance, *R*, is adjusted until the galvanometer shows that no current flows through

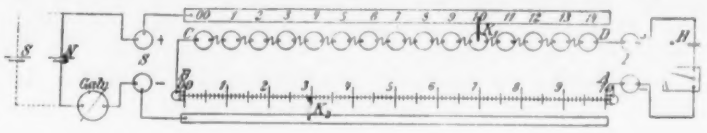


FIG. 3.

the standard cell circuit, then the voltage drop produced by the accumulator current corresponds exactly to the numerical values on the scale. If, therefore, the e.m.f. *S* to be measured is substituted for the standard cell, *N*, and the sliding contacts, K_1 and K_2, are adjusted so that no current flows through the standard cell circuit, the figures on the scale for K_1 and K_2 give the e.m.f. *S* directly in volts. In this form the apparatus is, therefore, suitable for measuring any e.m.f. between 0.1 and 1.5 volts. In order to apply the instrument to the

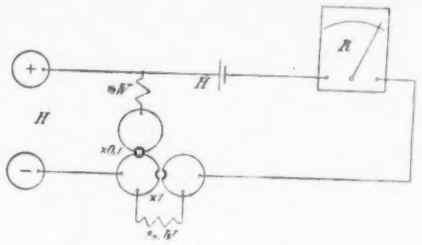


FIG. 4.

measurement of higher and lower e.m.f's, the author uses the following devices which are not new in principle, but are said to have not been used before in connection with compensation apparatus. For the measurement of e.m.f's between 0.1 and 0.001 volt, the author provides suitable additional resistances which are in a fixed relation to the total resistance, *W*, namely, shunt resistances equal to 1/9 *W* or 1/99 *W*, and series resistances 9/10 *W*, or 99/100 *W*, as shown in Fig. 4. The effect of these resistances is a reduction of the

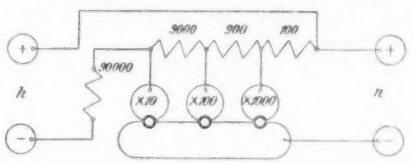


FIG. 5.

current in the compensator, so that the total voltage drop is now only one-tenth or one-hundredth of the original value. The figures read from the scale are, therefore, now to be divided by 10 or 100 in order to find the e.m.f. *S* directly in volts. For measuring an e.m.f. *h* greater than 1.5 volt, the arrangement of Fig. 5 is used. Four resistances of 100, 900, 9,000 and 90,000 ohms (together 100,000 ohms), are connected in series with *h*. By inserting a plug, it is easy to either connect the terminals *n* to 100, 1,000 or 10,000 ohms; i. e., to 1/1000, 1/100 or 1/10 of the total resistance, 100,000 ohms. The voltage, *n*, can thus be made to be between 0.1 and 1.5 volt and the compensation apparatus gives the e.m.f. *h* directly in volts, if the reading of the scale is multiplied by 1,000 or 100 or 10. Several constructions of the apparatus based on these principles are described.—*Elek. Zeit.*, November 26.

Measuring the Frequency of Very Rapidly Alternating Currents.—SALOMONSON.—In a paper on the variation of pitch of the "whistling arc," caused by the variation of the primary current, he had given some results of measurements by Peukert's method of the frequency of the so-called "Duddell currents," a frequency of 268,000 periods per second being observed. Duddell had recently remarked that a measurement with Peukert's method, giving a frequency of the order of 100,000 periods per second ought to be distrusted. The author now gives his reasons why he believes this method to be generally correct, although somewhat inexact at high frequencies. He has now devised the following method for measuring such high frequencies with greater accuracy. The arc lamp is shunted by a condenser and a self-induction which is the primary of a transformer,

the secondary being in series with an adjustable condenser and a hot-wire galvanometer. If periodic currents are generated in the first circuit by establishing a singing arc, an impressed e.m.f. will be set up in the secondary circuit and will generate a current of the same frequency as that of the original primary current. This current will be a maximum when the natural frequency of the secondary circuit corresponds with the frequency of the impressed e.m.f. The capacity of the condenser in the secondary circuit is varied until the ammeter shows a maximum current and thus indicates the condition of resonance, the adjustment being very easy. The frequency may then be calculated from the known self-inductance and capacity in the secondary circuit. To confirm his results the author measured the frequency by photographing the singing arc with the aid of a revolving mirror. From his experiments he concludes that a current in the primary circuit closely approximates a simple periodic current without harmonics of any appreciable intensity. He observed sinusoidal currents with a frequency of more than 400,000 periods per second.—Lond. *Elec.*, November 13.

REFERENCES.

Magnetometer.—Chree.—An abstract of a (London) Physical Society paper. He had previously found theoretically that the bending of the deflection bar of an ordinary magnetometer, under the combined weight of the bar and its load, must increase the distance between the deflecting and deflected magnets, during determination of the horizontal force, to an extent which is not negligible. He has now confirmed this conclusion by direct observations made at the National Physical Laboratory on a number of magnetometer bars. including specimens from the leading makers. Various attempts have been made to get rid of the bending effect, but the author believes that if this effect can be measured accurately it is of minor importance.—Lond. *Elec.*, November 6.

Calometric Method for Testing Electrical Generators.—See the abstract under "Dynamos, etc."

MISCELLANEOUS.

Presidential Address.—Gray.—A full reprint of his presidential address delivered before the (British) Institution of Electrical Engineers. In the introduction he distinguishes between an institution as a body for dealing with technical interests and an association as a corporation whose functions are related to everything affecting general interests. He hopes that the (British) Institution of Electrical Engineers will for some time yet continue to take an interest in things general as well as technical, although in future it will fall back into its proper function as an institution. He then discusses at some length the influences of legislation on electrical enterprises in Great Britain and gives a summary of the present conditions of electrical engineering. Exclusive of traction motors, in March, 1903, lamps and motors equivalent to over 14,000,000 lamps of 8 cp were connected in Great Britain to the mains of public electricity supply undertakings, London being represented to the extent of about 5,000,000. About 300 towns had an electricity supply, this number including, with two exceptions, all the towns whose population exceeds 100,000. Exclusive of power companies, the public supply stations had motors amounting to 55,000 hp connected to their mains. Municipal undertakings own generating plant of a rated capacity of 320,000 kw, and private undertakings are represented by 160,000. In London the companies are proprietors of about 100,000 kw, whereas the public bodies are responsible for about 28,000. The pre-eminence of the companies in London is due to the fact that they acted as pioneers and were first in the field. The average rated capacity of a British station is 1,400 kw. Present tendencies in Great Britain are decidedly in favor of the direct-current system with three-wire distribution. The author then gives a summary of recent progress in electric lighting, power generation and transmission, traction, telegraphy, and electrochemistry. He speaks of America as the electrochemical headquarters of the world.—Lond. *Elec.*, November 13.

REFERENCE.

Slide Rule.—Barth.—A fully-illustrated paper on slide rules for the machine shop as a part of the Taylor system of management.—*Eng. News*, December 10.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wave Detector for Wireless Telegraphy.—Schloemilch.—An illustrated description of a new wave detector, the principle of which is based on the fact that when an ordinary polarized cell (platinum or gold electrodes in dilute acid) is connected to an e.m.f. slightly greater than the e.m.f. of decomposition, so that a continuous current flows through the cell with a slight development of gas at the electrodes, an ammeter in the circuit shows an increase of the current when electric waves reach the cell. This effect is very pronounced if the electrode which is anode (at which oxygen is developed) is made very small. The author uses a wire of 0.001 mm. diameter and 0.01 mm. length. The arrangement of the apparatus is shown in the adjoining diagram, in which L is the vertical wire provided

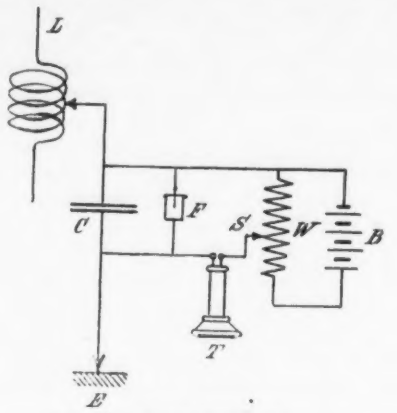


FIG. 6.—WAVE DETECTOR.

with some inductance windings, C is a variable capacity, in shunt with the polarization cell, F, which acts as wave detector; T is a telephone and W a sliding contact which enables one to adjust the e.m.f. impressed on the ends of the polarization cell. The action of the polarization cell is not yet explained, and it is still an open question whether the cell represents an ohmic resistance or a capacity, although the former seems more probable.—*Elek. Zeit.*, November 19.

Wireless Telegraphy.—The first part of a long abstract of the official report of the preliminary International Wireless Telegraph Conference, held in Berlin in August. There is also an editorial on this subject, pointing out that under the present state of the law in Great Britain the government has no right to interfere with any wireless telegraph company unless the company is sending commercial messages between two stations, both within the boundaries of the kingdom. This condition caused the position of reserve taken up by the British delegates to the conference. They could only point out that the British Government has no power to impose the regulations and restrictions agreed upon by the other nations (with the exception of Italy). It is said that the British Government cannot be justly accused of want of consideration to the claims of Marconi and his associates, and that it might now fairly turn its attention to the question of widening the field of wireless telegraphy by a judicious use of a beneficent state control.—Lond. *Elec.*, November 20.

New Books.

La Telegraphie Sans Fil. By E. Guarini. Bruxelles: Ramlot Freres et Soeurs. 64 pages, 88 illustrations. Price, 2.50 francs.

This little volume is one of a series of little works intended to form a library of industrial science. The text is a reproduction of a number of articles contributed to periodicals by M. Guarini, several of which appeared originally in these columns, and treats principally of Marconi's achievements and the author's experiments in wireless telegraphy. The book opens with a highly complimentary appreciation of Marconi, and the various chapters relate to the origin and the principal developments of the Marconi system, including his experiments at Spezzia in 1897; between England and France in 1899; between Poole and St. Catherines in 1900, and his trials between Corsica and France in 1901, and those across the Atlantic in 1901 and 1903. A discourse on the propagation of electric waves and the commercial value of the Marconi system form the concluding chapters. It is a very complete account of Marconi's work and from its favorable tone one might easily make a guess that Guarini had sold his patents to the Marconi interests.

Tools and Machines. By Charles Barnard. New York: Silver, Burdett & Company. 164 pages, illustrated. Price, 60 cents.

Mr. Barnard has written a readable book in conversational tone throughout so as to hold easily the attention of the reader. He deals with the ordinary tools of the household, pointing out the functions

of each, giving hints as to the kinds of tool to be used for different sorts of work, tracing the growth of the finished product from prehistoric times and then dilating upon the extension of the ordinary tool as seen in power machines. This is particularly shown in his chapter on hammers, where he shows that the original hammer was undoubtedly made of stone, and gives an interesting talk on the manner in which the hammer proper was first attached to a handle and then goes on through the various uses to which the hammer is put until he speaks of the power hammer. Other chapters on cutting and boring tools, abraders, etc., follow in natural sequence.

In addition to the 158 pages that the book contains there are added six pages of index, in which over 400 references are made to tools and appliances mentioned throughout the book. It is a useful book in the home where there is a growing boy with a mechanical turn of mind.

Automatic Track Switch for Street Railways.

A new electromagnetic track switch has been recently placed on the market by the American Automatic Switch Company, of New York, the advantages of which lie in its durability, simplicity, certainty of operation and safety from lightning. It is illustrated herewith in Figs. 1, 2 and 3. The principal operating parts consist of

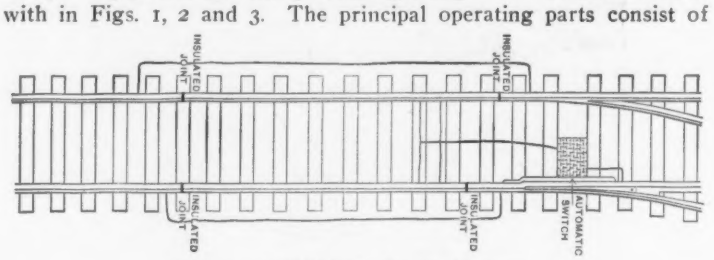


FIG. 1.—AUTOMATIC TRACK SWITCH.

but one magnet and one steel cam plate for the reverse motion. The magnet is immersed in a special oil in a sealed case, giving it absolute protection from moisture. The switch may be adapted to take operating current either through rail or overhead wire.

The motorman on a road thus equipped leaves the controller at one or two points while passing over the breaker or insulated rail. If the switch is right the car passes over the breaker or insulated rail with the power off. This method is very simple and prevents the motorman from becoming careless, but it is unnecessary for the motorman to memorize switches in order to operate them. The switch mechanism is made of the finest tool steel. There are no

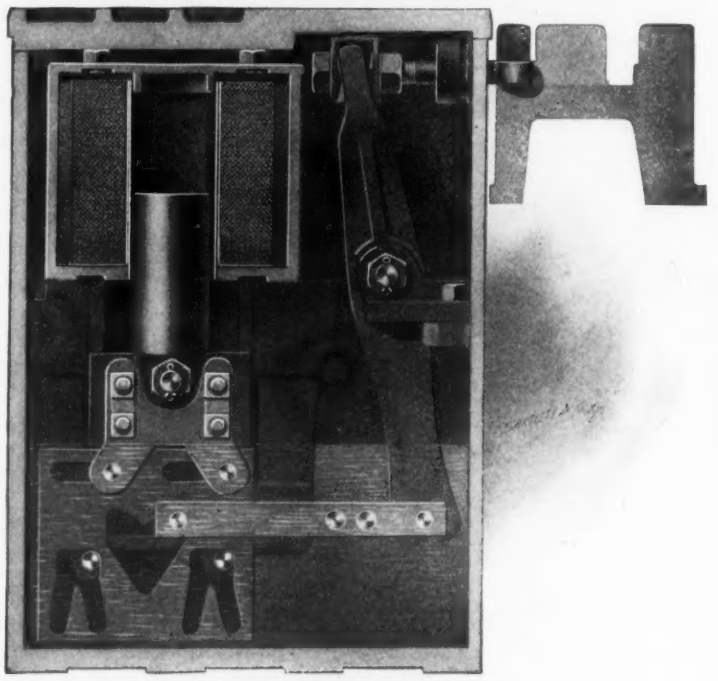


FIG. 2.—SWITCH MECHANISM.

wearing surface or pivoted points, nor is there any chance for short-circuits. As the operating mechanism is enclosed in a strong sealed box placed under ground, no dirt, water, salt or ice can come in contact with the magnet or the working parts. The cam plate produces a semi-lock, but does not prevent the turning of the switch with the switch iron. The switch is easily accessible for inspection. It is also stated that switch tongue splitting and car derailments are impossible. There are no boxes on poles, as the breaker may be placed near the switch. The breaker is arranged to spring on the trolley wire without cutting it.

One of these switches has been in practical operation for the last nine months at One Hundred and Forty-ninth Street and Eighth Avenue, New York, and has given excellent satisfaction. The company also has orders for installing these switches in Brooklyn,

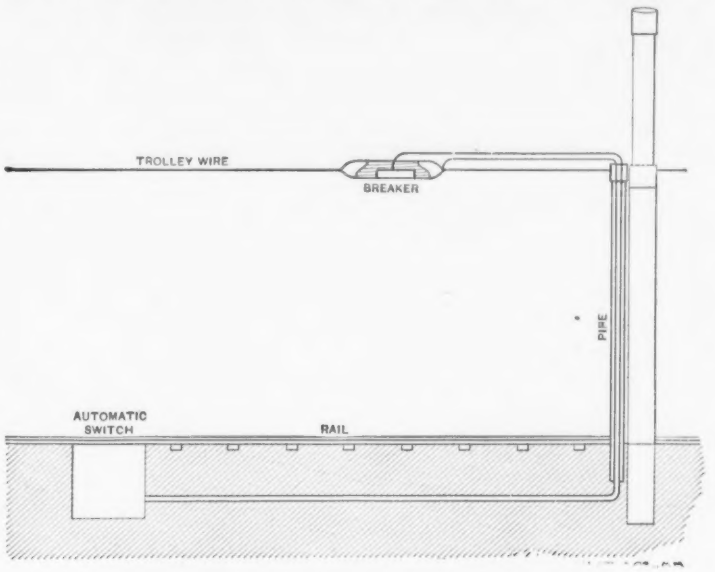


FIG. 3.—OVERHEAD CONNECTIONS.

on the system of the Public Service Corporation of New Jersey, and at Albany, Utica, Trenton, Cleveland and other cities. Mr. Aldred K. Warren, the consulting engineer of the Automatic Switch Company, which has developed this system, was formerly assistant engineer of the equipment of line of the Brooklyn Rapid Transit Company and for the last year and a half has been one of the electrical engineers of the Interborough Rapid Transit Railway Company.

Adjuster for Incandescent Lamps.

A simple and novel form of adjuster for incandescent lamps called the "Electrogrip" has been placed on the market by the Applied Device Company, of 56 Harrison Avenue, Springfield, Mass. It is clearly illustrated in the two cuts herewith, Figs. 1 and 2. By pressing the arms or jaws of the device toward the central axis, as shown in Fig. 1, the jaws open, and then attachment can be made to the

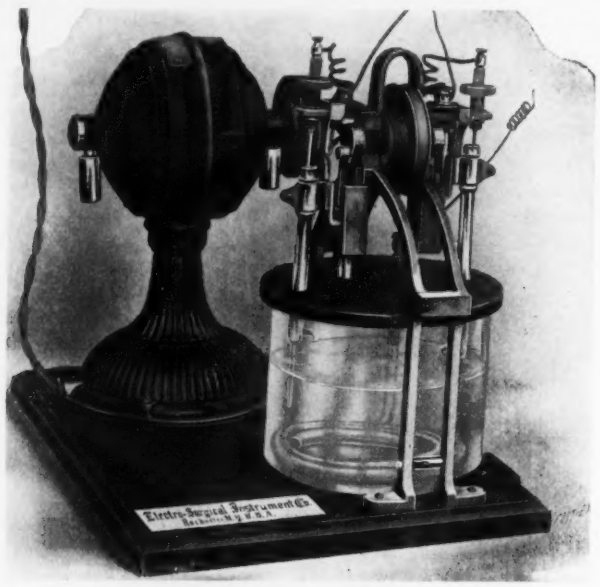
FIGS. 1 AND 2.—LAMP ADJUSTER.

desired object, the springs at once tightening the grip as they revert to normal. In Fig. 2 the appliance is shown fixed on a machine tool, enabling the workman to throw the light just where he wants it without any further bother as to the adjustment of the lamp. It is an "approved" device.

Current Interrupter.

Mr. T. A. Houghton, of Rochester, N. Y., has assigned to the Electro-Surgical Instrument Company, Rochester, N. Y., a patent recently granted to him on a current interrupter, which is a combination of the electrolytic and mechanical break, and is claimed to reduce the amount of current flowing to the minimum. For very heavy work, in connection with Röntgen-ray coils, the current is only from ¼ of an ampere to 4 or 5 amperes, whereas it is claimed that types of interrupters, such as the Wehnelt, etc., use a current of from 5 to 18 amperes with no better results, and constantly endangering the vital parts of the coil and tubes. This type of interrupter is double in all its working parts, and is motor-driven. There is an alternate action, the positive fork wire marked (+) entering at binding posts (1) and (2) respectively, one acting while the other is cut off by the glass sliding over the wire in the liquid; then in one revolution of the shaft the other wire is exposed to the liquid.

The interrupter will work very slowly, thereby giving momentary surges of current through Röntgen-ray tubes, coming slowly to a maximum, then slowly receding to the minimum; if the current were left at the maximum it would fuse the anode, but moving slowly, the platinum anode has time to cool somewhat between the surges. For radiographic work extremely clear negatives have been made of the hand with but five of these surges; more surges, of course, would be necessary for the denser parts of the body. Slower interruptions can



CURRENT INTERRUPTER.

be obtained by detaching one of the points of the forked wire, thereby making the interrupter single-acting. However, the very rapid interruptions possible with the double action make an almost constant spark or flow of current through tubes.

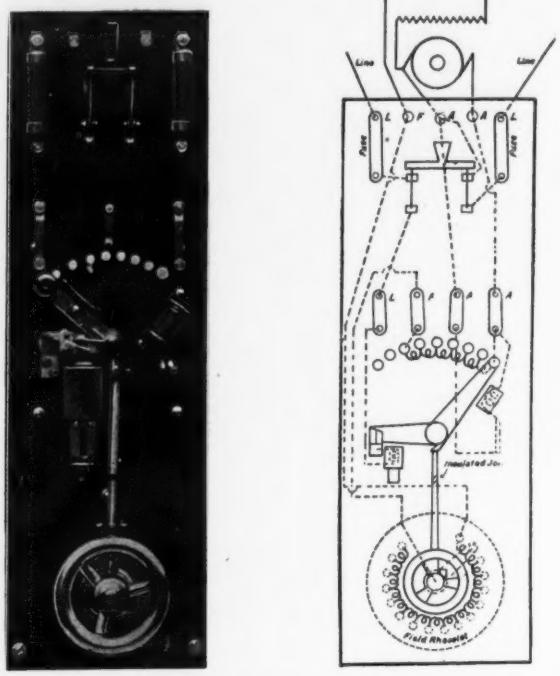
This interrupter can be used with any coils with which interrupters are now used, including tubes with thin platinum anodes designed for static machines.

It is stated that the interrupter works equally well on a ¼-in. or a 52-in. spark coil. In use with a 12-in. coil a good, heavy discharge can be obtained with from one to two amperes to the limit of the coil. It also makes a very efficient substitute for the rotary converter used in transforming direct current into a suitable current for cautery work; and it provides a convenient means of regulating current strength, thereby taking the place of a rheostat and rotary converter for this work. One of its applications owing to the small amount of current consumed from the supply source is in connection with coils for electrotherapeutic work, such as with vacuum electrodes, ozone tubes, brushes, ultra-violet apparatus, high tension coils, etc.; in fact, owing to the small amount of current and very great amount of voltage, the current is so similar to that generated by static apparatus that, it is claimed, any form of treatment possible with the static machine is possible with this interrupter in connection with any coil. Owing to the absolute mechanical make and break in connection with the electrolytic break, in coils of ¼ to 1-in. spark there is barely enough current passing to move the needle of an ordinary Weston ammeter graduated from 0 to 1 ampere. This interrupter, when used with a very slow motion, gives a great momentary surge of the induced current, then recedes to an absolute break, thus making it applicable to wireless telegraph apparatus.

Electric Motor Starters and Controlling Panels.

The accompanying illustrations show several types of panels and controlling devices recently placed upon the market by the Ward Leonard Electric Company, of Bronxville, N. Y. Some of the important features cited below and shown in the illustrations were developed to meet the demands of variable-speed motor control.

Fig. 1 shows a panel built for the United States Government, having a number of important features. It is self-contained and



FIGS. 1 AND 2.—CONTROLLING PANEL AND DIAGRAM OF SAME.

complete. The no-voltage release magnet is connected across the armature terminals and is independent of the amperes in the field circuit. This prevents the flying back of the starting arm when the field is weakened. The overload device is a positive protection against overload at all times and consists of an independent inter-

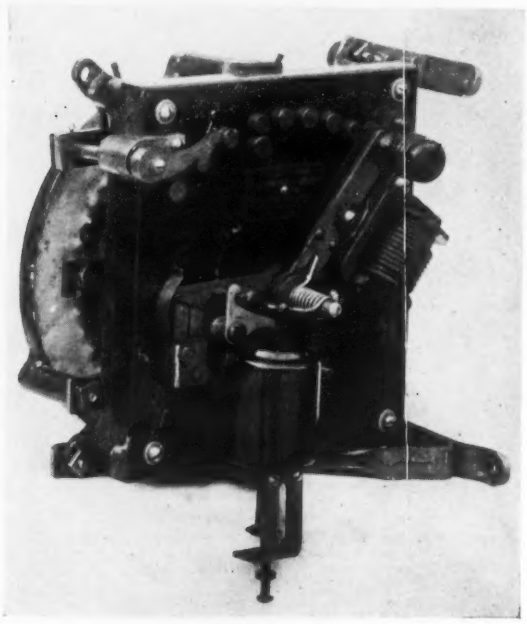


FIG. 3.—CONTROLLING OUTFIT WITHOUT SWITCH AND FUSES.

locking circuit-breaker. This prevents the blowing of fuses during the period of starting. Fig. 2 shows the diagram of connections of the panel.

Other features are that the field rheostat is so interlocked with the starter that the motor cannot be started under conditions of weak field. This prevents the possibility of overloading the motor armature, due to starting the motor under load with a weakened

field; the field rheostat has any number of steps desired from 30 to 150 or more, giving even control of the amperes in the field or the speed of the motor; the panel is water-proof, fulfilling the

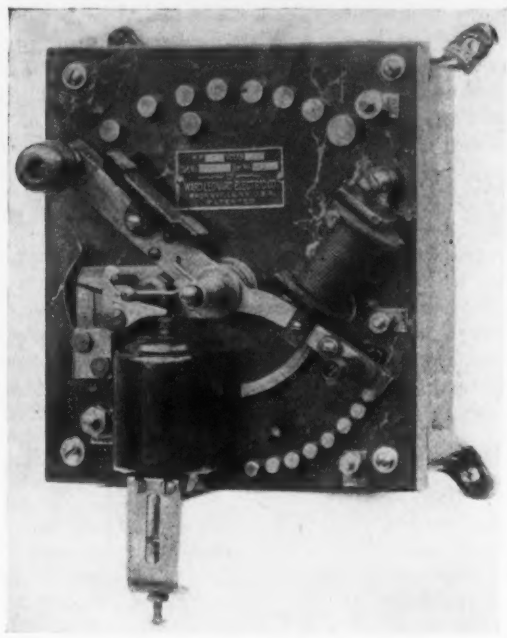


FIG. 4.—COMBINED STARTER AND FIELD REGULATOR.

United States Government specifications, the most accurate and strict of those covering motor starters.

Fig. 3 shows another type of controlling outfit without the switch and fuses, but having all the other advantages cited above, arranged to meet the desired requirements as to location, space, etc. Fig. 4 shows the starter and field regulator all on one box. This box has the interlocking features, but has not more than 10 points of field control.

The Evolution of the General Electric Transformer.

The General Electric Company has issued an interesting pamphlet entitled, "Fifteen Years Experience in Transformer Design," in which, after sketching the pioneer work of Faraday, Ruhmkorff and Varley and Ferranti, the story of the evolution of the present General Electric types is taken up.

The Thomson-Houston Company, predecessor of the General Electric Company, commenced the manufacture of transformers in 1888-89 with two types, both employing the shell type of core. Notwithstanding the fact that these transformers represented the highest development in transformer construction of that period, the year 1889 witnessed the introduction of a new type, which embodied improvements in insulation and a marked reduction in core losses. In 1890, with the experience gained from nearly thirty thousand transformers installed, a new design was produced. This embraced a much larger range of sizes than had hitherto been provided, and employed more modern methods of utilizing insulating material while giving again a marked reduction in the iron losses as shown on page 17. The shell type of core was still employed. Over fifty-three thousand transformers of this design were installed within the six years following, the average size increasing during that period from 1.14 kw to 3.2 kw.

The earlier transformer systems were all operated at high frequency, and with the subsequent growth of low frequency plants came a demand for suitable transformers. Many sizes of the new transformers were operated at 60 cycles, but with objectionably high core losses, and in 1894 a transformer was specially designed for 60-cycle service.

The Thomson-Houston Company, under the inspiration of Prof. Elihu Thomson, was among the first in the commercial use of oil-cooled transformers. The use of oil in transformers not only increased the value of the insulation and prolonged its life, but also provided a means whereby the heat generated within the core and windings would be conveyed to the surrounding case and readily dissipated into the air. To employ the advantages thus afforded, the Thomson-Houston Company's transformers were as early as 1889 provided with oil-tight cases. With its later types the use of oil was again strongly recommended, and as the possibility of carrying a greater load with a given heating, and the lessened risk of damage from lightning became recognized, the use of oil gradually increased, and to-day it is the standard practice in the United States.

In 1895 the engineers of the General Electric Company made a thorough investigation of the relative merits of various forms of cores and methods of winding and insulating. In this investigation the designers had before them the consideration of lessened risk from accident as well as the greatest economy of construction and the proportioning of losses to give the highest economy of operation. It was found that the long-neglected type of core first used by Ruhmkorff, combined with concentric cylindrical primary and secondary windings, gave a combination which was most excellent for transformers of small and moderate capacity. This form was particularly advantageous in that the insulation between the high and low potential windings could consist of an approximately cylindrical tube of simple construction. The result of these investigations is the present General Electric transformer type.

Mica, the best and most durable insulating material, cannot, unfortunately, be bent around sharp corners without injury, and cannot, therefore, be made to protect the sides, edges and corners of the several flat coils in a shell type transformer. In the cylindrical insulations of the core type design, however, it is employed under the best conditions. Many accidents have happened with small, shell type transformers, due to the primary current passing from the core to the secondary. Owing to the many complicated surfaces to insulate in a shell transformer, the designer is tempted to reduce the insulation below the safety point in the small sizes where the insulation at best must occupy a large percentage of the total available winding space. Since the primary coils of the core type transformer are not adjacent to the core, this danger is avoided.

Low reactance is essential to good regulation. As a result of the favorable form of winding space in the core type transformer, the required low reactance is obtained, it is claimed, without the numerous subdivisions of primary and secondary coils required in all but the smallest sizes of shell type transformers.

Comparing the core type and the shell type designs of a given size, it is stated that the former has a much lower voltage per turn of wire and a far greater number of turns in series. Consequently each layer of wire may be of considerably greater length without increasing the voltage between layers over that found in the corresponding transformer of the shell type. An additional safety factor was introduced in the new transformer by dividing the primary into four distinct coils, each occupying somewhat less than one-half the available winding length. After carefully scrutinizing all cases of transformer trouble the General Electric Company's engineers concluded that break-downs within the windings of oil-immersed transformers were generally due to moisture absorbed by the fibrous insulations before being immersed in oil. In some cases water had become mixed with the oil and was absorbed by the windings. To overcome this difficulty there was developed a system of treatment by which the coils, first dried in a vacuum, are thoroughly impregnated with a specially prepared waterproofing compound which, liquified by high temperature, is forced under heavy pressure into every interstice of the windings. This process, it is stated, was first put into permanent commercial use by the General Electric Company, and was applied to the new type in 1898.

When a transformer feeds a three-wire service, each portion of the secondary winding must be in intimate relation with the entire active primary; otherwise unbalanced voltages will be found when operating unbalanced loads. This feature was fully investigated with special reference to core type transformers, and all such transformers designed for three-wire secondary service have been provided with a "balanced" form of winding which gives perfect distribution under all conditions of load.

The universal application of series multiple, primary connection boards on all sizes of lighting transformers was introduced by the General Electric Company in 1897.

The many improvements first offered to the public in the new type of transformer were not limited to the core and windings; a new type of box was adopted from which the lead wires pass vertically downward from overhanging lead pockets. The value of this improvement is well demonstrated by the fact that this construction has become standard.

Simultaneously with the developments which led to the introduction of the latest type, the subject of transformer iron was investigated, with regard to the effects of variations in chemical analysis, treatment during manufacture, and special processes of supplementary treatment. The object sought was not only an improvement in the initial quality of the iron but particularly a freedom from that "fatigue" or ageing, the serious nature of which was even then recognized.* These investigations and the special processes developed from them have resulted in materially lower specific losses, a remarkable constancy, and a degree of uniformity in commercial production hitherto unknown. In addition to numerous factory tests, over five hundred transformers have been recalled from actual service, and the core losses before and after service compared. The average result shows a negligibly small percentage of "aging" or increase in core loss while in service.

Type	600 Watt	2500 Watt	7500 Watt	30 Kw.
B (1889)	140 Watts	290 Watts		
E (1889)	117 Watts	173 Watts		
F (1890)	47 Watts	104 Watts	250 Watts	
G (1894)	38 Watts	76 Watts	156 Watts	
H (1896)	25 Watts	48 Watts	116 Watts	370 Watts
H (1903)	23 Watts	45 Watts	96 Watts	230 Watts

The above table shows the improvement in the core losses of transformers. All the figures are based for comparison on 60-cycle measurements.

New Switch Pattern Set.

The new pattern switch set lately designed by Foote, Pierson & Co., 82-84 Fulton Street, New York City, has four groups of coils consisting of 10 units, 10 tens, 10 hundreds and 10 thousands, and with bridge arms of 10, 100 and 1,000 ohms each.

The resistance is varied by means of special phosphor bronze switches moving over platinum-faced contact studs. The switches consist of several leaves of metal so arranged that each leaf comes in contact successively and with sufficient pressure to insure absolute contact. The platinum studs present at all times a bright surface, which does away with the necessity of cleaning. The resistances are arranged on the decade plan, and the numbers on the plates, as shown in the illustration, give the reading direct of the

SWITCH SET.

number of coils in circuit. These plates are finished with a black metallic surface and filled in with white letters.

Keys for galvanometer and battery are arranged in circuit, and have an adjustable pressure screw which allows for the adjustment of the tension of the springs, also forming a guide for the keys, which keeps them from sliding off the platinum-faced studs. Each key has in circuit a small single point switch which throws in or out either of the keys.

A special switch and binding post are arranged with ground connection, so that either the Murray or Varley loop tests can be made. Binding posts for galvanometer, battery and line are placed in the most convenient places for use. The brass work, switches, etc., are mounted on highly polished hard rubber plate, and the different circuits are outlined in white on the plate, giving the operator the advantage of easily tracing out the different connections.

The set is contained in a highly polished mahogany box, and throughout shows excellent material and workmanship.

* See General Electric Company's publications, "Aging of Transformer Iron," and "Sheet Steel for Transformers."

New Submarine Cable Plant.

The John A. Roebling's Sons Company has just completed a new building which will enable it to increase largely its product of insulated wires and cables of all kinds, and will provide room for introducing on an adequate scale the manufacture of submarine cables. It has made submarine cables for many years, but this part of its business seems to demand greater facilities, and to provide for this one of the largest and most complete plants in this country will be installed. The new buildings are located so that shipments may be made by either water or rail, and they will soon be in a position to solicit the largest contracts in this line.

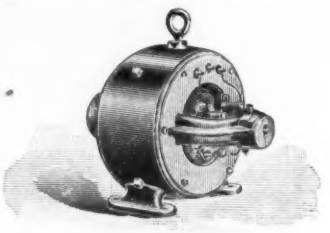
Both rubber and gutta percha core is used and the company's present large rubber plant will take care of those orders calling for rubber-insulated cables. Formerly it has imported gutta percha core, but it is its intention in the new plant to provide a complete factory for manufacturing this core under the direction of a most competent and experienced manager, who has had a long and successful experience abroad in this kind of work. It is its intention to so equip the new factory that submarine cables of any kind of core, with any description of armor, may not only be made, and to provide the necessary apparatus and equipment to lay any of the cables it manufactures.

The Roebling Company will be in a distinct position not only in the variety of insulations it can furnish, but also from the fact that it will be prepared to take contracts to turn over to the purchaser, the submarine cable laid and ready for use. It will also have the advantage of manufacturing all the constituent parts of a cable, viz.: copper wire, insulated core and armor wire. This should not only reduce the cost, but it should insure to the purchaser the very best materials, all manufactured under one supervision, and for which one company will be responsible.

The Roebling Company has always undertaken contracts boldly and successfully, and there is no reasonable doubt that its new factory will soon be engaged on heavy government contracts for this class of materials.

Small Multipolar Motors.

Among its latest types of motors brought out by the Fidelity Electric Company, of Lancaster, Pa., is that shown in the cut, built from ⅛ to 10 hp, which recommends itself on account of its adaptability for back gearing, or for inverting for ceiling suspension. The motors are all multipolar and of moderate speed. The body castings are of cast steel, of the highest permeability, the body being cast in one piece. The field coils are form wound, dipped in a special insulating compound and wrapped with varnished linen, before being taped. The armature is barrel wound, and of the ventilated type, air ducts being provided from the interior of the core to the exterior. The commutators are constructed of drop forged bars, and the washers and core of carbon steel to withstand the strain of drawing up in course of construction. The brush holders are so constructed that the amount of tension of the spring can be either increased or reduced by moving the end of the spring in the notches provided on the back of the holder. The sliding bases in the larger sizes are parallel machined sliding bars, and in the smaller, the now almost universally used platform base.



MOTOR.

The Fidelity Electric Company, Incorporated, of Lancaster, Pa., was formerly the Geo. C. Towle Manufacturing Company, which has lately been reorganized with $50,000 capital. They began as manufacturers, in 1896, of fan motors exclusively, then added a line of small power motors and generators, which they have gradually increased in capacity. They have lately added a special type of horizontal boring mill, weighing about three tons, which reduces the amount of machine work several hours on each machine, allowing the motor bodies to be faced and bored in one operation. The total floor space of their buildings is 12,000 square feet. The officers of the new company are: C. F. Stauffer, president; B. G. Stauffer, treasurer and general manager; M. S. Graver, secretary.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The prices of stocks reacted after an advance led by the Steel and traction group. There was a tendency on the part of bearish interests to circulate unfavorable rumors about various properties, particularly United States Steel and Brooklyn Rapid Transit, which latter, together with the other tractions, were features, despite their later tendency to sell off. Standard railroad stocks were held fairly well, and were less active. On Thursday Brooklyn Rapid Transit advanced to 53⅝, and other members of the traction group made corresponding gains. At the close Brooklyn Rapid Transit had receded to 48⅛, the total number of shares sold being 497,700. The lowest point reached was 46¾. Metropolitan Street Railway, on sales of 36,600, made a net gain of 1¼ points, closing at 121¼, the highest and lowest quotations being 124¾ and 120¼, respectively. General Electric made a gain of 5 points, closing at 165, after having touched 160¼. The sales of this stock aggregated 5,600 shares. Westinghouse common fluctuated between 149 and 160, closing at 152, this being a net gain of 3¼ points, 15,700 shares having been sold in the course of the week. Western Union closed at 87—a net loss of ⅜ point; American Telegraph and Cable closed at 81, this being a gain of 3½ points. Following are the closing quotations of December 15:

NEW YORK

	Dec. 8	Dec. 15		Dec. 8	Dec 1
American Tel. & Cable	78	80	General Electric	163¼	164
American Tel. & Tel.	127	125	Hudson River Tel.	..	..
American Dist. Tel	24	23	Metropolitan St. Ry.	120⅛	121¼
Brooklyn Rapid Transit	46⅜	49⅜	N. E. Elec. Veh. Trus.	..	..
Commercial Cable	152	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	*23	Marconi Tel.	..	..
Electric Boat pfd.	49⅛	48	Western Union Tel.	87½	..
Electric Lead Reduction	⅝	⅝	Westinghouse com.	156⅛	155⅛
Electric Vehicle	5¾	5¾	Westinghouse pfd.	185	185
Electric Vehicle pfd.	8	8			

BOSTON.

	Dec. 8	Dec. 15		Dec. 8	Dec. 15
American Tel. & Tel	127	125¾	Western Tel. & Tel. pfd.	*82	79½
Cumberland Telephone	*	*115	Mexican Telephone	1¼	1⅜
Edison Elec. Illum.		231	New England Telephone	120	122
General Electric		163	Mass. Elec. Ry.	20	18⅛
Western Tel. & Tel.	7⅛	7⅛	Mass. Elec Ry. pfd.	75	76

PHILADELPHIA.

	Dec. 8	Dec. 15		Dec. 8	Dec. 1
American Railways	42	42¼	Phila. Traction	95⅛	..
Elec. Storage battery	53	53	Phila. Electric	6⅛	6⅛
Elec. Storage Battery pfd.	53	53	Phila. Rapid Trans.	11	10½
Elec. Co. of America.	8	8			

CHICAGO.

	Dec. 8	Dec. 15		Dec. 8	Dec. 15
Central Union Tel.	..	..	National Carbon pfd.	86	90
Chicago Edison	144½		Metropolitan Elev. com.	17	16
Chicago City Ry.	160	159¾	Union Traction	5½	6
Chicago Tel. Co	..	..	Union Traction pfd.	28	25
National Carbon	25	20			

*Asked

"SOO" SALE.—All the assets of the Consolidated Lake Superior Company, capitalized at $122,000,000, and owned largely in Philadelphia and Canada, were sold by auction this week by Adrian H. Muller & Son, auctioneers, to Speyer & Co., who were represented by E. C. Henderson, for $4,500,000. Notice was served on the auctioneer by Receiver J. G. Carruth of an action which has been begun in the Supreme Court of New York to set aside the agreement between the officers of the company and Speyer & Co., which, if successful, would render the sale nugatory and void. A protest was read from Francis C. Davison, who says he owns 100 common and 50 shares of the preferred stock of the company. He claimed the sale would not be legal because the agreement between Speyer & Co. and the officers of the company was made without the authority of the stockholders. Notices of liens on various properties were filed by the Stanley Electric Manufacturing Company, Frawley Bros., Colgan & Whelan and others.

BELL TELEPHONE DIVIDENDS.—Advices from Boston say: "There is no question but that there has been selling of American Telephone stock by prominent trustee interests who fear that the 'extra' dividends are not of long duration. The selling movement in American Telephone became more pronounced when the Bell Telephone Company, of Philadelphia, in which the American Company owns 80 per cent. of the $12,000,000 stock, reduced its dividend from 8 to 6 per cent., for this action was considered by the street an advance notice of a coming change in American Telephone & Telegraph Company's dividend policy. It can be officially stated, however, that earnings of the American Telephone & Telegraph Company are considerably in excess of last year, the business never in a more prosperous condition, and that fears of reduced dividends on American Telephone stock have no present basis in fact. No change is in sight for the next four dividends at least."

DIVIDENDS.—The directors of United Traction & Electric Company, of New Jersey, have declared the regular quarterly dividend of 1¼ per cent. on the capital stock, payable January 2. The directors of General Electric have declared the regular quarterly dividend of $2 on the common stock. The United Gas Improvement Company's directors have declared the regular quarterly dividend of 2 per cent. ($1) on the capital stock, payable January 15. A dividend of 1¼ per cent. has been declared on Rochester Railway preferred, payable January 2. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable January 15. The Bell Telephone Company, of Philadelphia, directors have declared the usual quarterly dividend of 1½ per cent., payable January 25.

DENIAL OF DEAL.—Referring to an article in a daily paper about the merger of the General Electric Company and the Westinghouse Electric & Manufacturing Company, Mr. George Westinghouse authorizes the following statement: "There is no foundation whatever for the suggestion that the control of the Westinghouse & Manufacturing has passed into unfriendly hands. On the contrary, my friends, who are in accord with me, and I own a good deal more than a majority of the shares of the Westinghouse Electric & Manufacturing Company, and I may add that there is no record of any indications of dissension on the part of any shareholder."

WESTERN UNION EARNINGS.—The Western Union Telegraph Company issues its statement, partly estimated, for the last three and six months of the year, showing for the half year net revenues of $4,497,196, as compared with $4,364,504 last year. The actual returns for the September 30, 1903, quarter were: Net revenue, $2,347,196; bonds, interest, $286,300; balance, $2,060,896; dividends, $1,217,017; surplus, $843,879; previous surplus, $13,019,724; total surplus, $13,863,603. The regular quarterly dividend of 1¼ per cent. is payable January 15.

BOSTON ELEVATED ANNUAL.—The annual financial statement of the Boston Elevated Railway Company shows an increase in every item, with the single exception of a decrease of $1,100 in rental paid for the use of the subway. Net earnings were $3,699,654, being $241,195 greater than last year. The aggregate number of round trips was 5,029,453, and 233,563,578 passengers paid fares, an increase of 11,078,767 passengers over the previous year. The general balance sheet showed total assets of $20,358,058, and a surplus of $2,327,687.

TELEPHONE COMPANIES DISSOLVED.—The Bell Telephone Company, the New England Telephone Company and the National Bell Telephone Company, on their own petition, were dissolved as Massachusetts corporations, in Boston, on December 8, by Judge Hammond, of the Supreme Court. The ground of the petition was that they are not now engaged in business, having been superseded by a corporation or corporations organized under the laws of another State.

PHILADELPHIA ELECTRIC COMPANY.—The Philadelphia Electric Company, which was chartered a year ago in Pennsylvania, has filed notice of an increase of capital stock from $100,000 to $2,500,000. The company will be controlled by the Philadelphia Electric Company, a New Jersey corporation, which controls the electric lighting in Philadelphia. The new company will operate all the subsidiary plants of the old company, and its entire stock issue will be owned by the New Jersey corporation.

BOSTON EDISON STOCK.—At a directors' meeting of the Eastern Illuminating Company, of Boston, the directors recommended stockholders to authorize an issue of 95,000 shares of new stock to be subscribed for early next year. This new stock is to partly capitalize recent purchases of suburban properties.

PEEKSKILL (N. Y.) EARNINGS.—The earnings of the Peekskill Lighting & Railroad Company for the September quarter show gross $19,789 and net $9,959, an increase of $1,011 over 1902. The surplus is $8,412, an increase of $1,868 over 1902.

ELECTRIC LIGHT MERGER.—An agreement merging the Plainfield Gas & Electric Company and the Somerset Lighting Company has been filed at Trenton, N. J.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade conditions in general are favorable, and a satisfactory and seasonable business is the rule. This applies particularly to retail trade. In the wholesale lines the usual season's quiet is noted, and there is some slackening in industry. A favorable condition is the easing of money, which is returning from the country more freely, although there is yet room for improvement in collections. Railway earnings are very satisfactory, and will show a gain of fully 5 per cent. over last November. The November export trade will, it is said, come close to the best previous records. Seasonable conditions, stock-taking or readjustments to lessened demand are all assignable reasons for the quieting down of outdoor activity, such as building, or for reduced running time or suspensions in a variety of industries employing large numbers of hands. The reduction in cotton mill wages now easily affects 80,000 operatives, and future wage scales are the subject of much thought in the iron and steel industry. Cotton has weakened and wheat is on the decline. In the iron trade it is believed that the lowest point has been reached, and there is a more hopeful feeling, while statistics are bearish the curtailment of production has cut the output one-third from the top. There was no marked demand for finished products. Copper showed some improvement, a large export business having been done. Home consumers are also entering the market. Prices have advanced to 12 to 12¼c. for Lake, 11¾ to 12c. for electrolytic, 11½ to 11¾c. for cathodes and casting stock. *Bradstreet's* reports 241 business failures during the week ending December 10, against 239 the previous week, and 247 the corresponding week last year. The liabilities of commercial failures thus far reported for December amount to $5,342,094, of which $2,725,036 were in manufacturing, $1,970,883 in trading, and $646,175 in other commercial lines.

MOTORS FOR SILK MILLS.—The Northern Engineering Company, 95 Liberty Street, New York, has recently secured a contract for a number of motors to be installed in the silk mills of Stehli Brothers. The High Point (N. C.) mills, operated by that concern, will be equipped with eleven motors of various sizes. Nine special machines of ½-hp capacity each will be built by the Northern people themselves, while one motor of 15 hp and one of 3-hp capacity will be furnished by the Commercial Electric Company, of Indianapolis, Ind. This equipment will be utilized in the silk throwing plant. The Stehli mills at Lancaster, Pa., are to have seven 10-hp Commercial motors and two of 15-hp capacity and of same manufacture. The Northern Engineering Company has has taken orders for two 10-hp Commercial motors for installation in the Auger & Simon Silk Dyeing Company's plant at Paterson, N. J. The Carteret (N. J.) plant of Bery Moore, manufacturer of paints, is to be equipped with one 30-kw Commercial generator with switchboard. This outfit is intended for lighting. Large wiring contracts have also been taken lately, especially in Paterson, N. J., where the company reports it has some $10,000 worth of work on hand. Among the wiring contracts is one for the Colt Building and the Danforth Free Public Library. In New York substantial wiring orders have also been received, one of the principal coming from the Knickerbocker Chocolate Company, 1,133 Broadway.

NOVEMBER FOREIGN TRADE.—The Bureau of Statistics report of the country's foreign commerce in November shows the largest monthly exports on record, with the exception of October, 1900, when they amounted to $163,389,680. Last November they were $160,455,590. The excess of exports is also the second largest in the country's history, the excess in October, 1900, being $92,758,646, while last month's was $83,393,784. The nearest approach to last month's excess (with the exception of October, 1900) was in December, 1808, when exports exceeded imports to the amount of $82,711,455. Comparing with October, November's exports do not show any very substantial increase, but imports fell off about $4,870,000, to which is due the larger excess that November shows. Over last year, however, November's exports show a very substantial increase, while imports corespondingly fell off, causing an advance in the excess of $43,580,000. The increase in exports was entirely due to agricultural shipments, which advanced $34,800,000, which, in turn, was caused by a very heavy increase in cotton exports. Non-agricultural shipments were only $450,000 above last year. Be this as it may, it is an excellent showing of the country's ability to maintain a large credit balance.

DETAILS OF ELECTRICAL EXPORT.—The details of electrical export show $413,458 of electrical machinery sent abroad during October, and $430,821 of electrical appliances and instruments, including telegraphs and telephones. The figures respectively for last year, on instruments, are $373,174, and on machinery, $677,623. The total of electrical machinery exported in the ten months was $4,288,551, as compared with $5,076,774 in 1902, and $4,916,656 in 1901. Electrical instruments for the ten months were $4,001,863, as compared with $3,447,280 in 1902 and $1,322,034 in 1901. The total in the two groups for the ten months this year is $8,290,414, as compared with $8,524,054 in 1902. In view of lower prices, these figures show how remarkably well electrical export trade has held up this year; and it will be seen that it is running along at the handsome rate of about $10,000,000 per annum.

BIDS IN NEW ZEALAND.—The Tramway Board, Christchurch, New Zealand, invite for tenders for the complete installation of an electric tramway system in that city. Tenders are returnable March 17, 1904. Specifications and schedules may be obtained on payment of a fee of £3 for section, or £25 for the complete set, from the office of the agent-general for New Zealand, in London. The sections are as follows: A. Power house equipment, steam plant. B. Power house equipment, electrical plant. C. Steel stack. D. Traveling crane. E. Cooling tower. F. Car bodies. G. Car trucks. H. Car motors. I. Compressed air brakes. J. Equipment of cars and sundry supplies. K. Repair shop tools. L. (1) Rails, fish-plates, fish-bolts and special work. L. (2) Permanent way. M. Overhead construction. N. Emergency wagon. O. Destination boxes, tablets and staff boxes. P. Life guards.

STARK SYSTEM IN CANADA.—The Stark Electrical System, Limited, of Toronto, Canada, notifies us as follows: "A new company, the Stark T., L. & P. System, Limited (Telephone, Light & Power), capital, $1,000,000, has been formed in Toronto, Canada, to take over the Humber Light & Power Company, Limited, at Toronto Junction. The new company will operate the Stark patents, whereby telephone, telegraph, light and power service is furnished from the one plant and over the same circuit. They will greatly increase the Humber Light & Power Company's plant and will immediately commence installing a telephone service in Toronto Junction, for which town they have received a franchise. The officers of the Stark system are H. Waddington, president; A. M. Stark, vice-president and manager, and W. N. Dollar, secretary.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports an unprecedented number of switchboard shipments for the first two weeks of December. The shipments reached over 2,000 lines capacity, and consisted mostly of the well-known "express" switchboard equipments. A partial list of the shipments is given below: Stanberry, Mo., two 220-line express switchboards; Gravette, Ark., one 100-line express switchboard; Russellville, Ark., one 200-line express switchboard; Buitman, Mo., one 100-line express switchboard; Sabetha, Kans., one 100-line express switchboard; Nicholsville, Ky., one 300-line express switchboard; Rushville, Mo., one 100-line express switchboard; Clark, S. Dak., one 100-line express switchboard.

100-TON CRANE.—The extensive new railroad shops of the Southern Pacific Railroad Company, at East Los Angeles, Cal., have been equipped with a 100-ton overhead traveling crane manufactured by the Niles-Bement-Pond Company and equipped with Westinghouse alternating-current motors. The severe tests to which the crane was recently subjected have proved satisfactory to the Southern Pacific officials. A 95-ton locomotive was lifted by the hoisting motors, which are arranged in two 50-hp units and additional weights were piled on until the chains were broken by the strain from the motors. There are a third 50-hp induction motor and several smaller induction motors on the crane operating auxiliary hoists, etc.

FERRACUTE MACHINE WORKS.—The Ferracute Machine Company, Bridgeton, N. J., through President Oberlin Smith, says with regard to its new plant: "We have built a temporary 50 by 100-ft. building over part of the ruins of our former works and are running several new machines together with some of the old ones that have been repaired. We have also rented a small machine shop near by and have built a temporary blacksmith shop. With this extemporized plant we are running about half of our usual force, but hope to get into a new fire-proof building after a few months."

RUBBER-COVERED WIRE.—Reports of all kinds are current in electrical circles as to the proposed pool in rubber-covered wire, exclusive of armored and lead-covered. A number of the large insulated-wire manufacturers are interested, it is said, in this movement, which has been on foot since October; but it cannot be learned that the matter has been brought to a finish yet. The idea is to check unhealthy competition and ruinous price-cutting.

BIG OMAHA CONTRACT.—A large contract has been let to the John F. Kelly Engineering Company, Singer Building, New York City, for a plant of 15,000 hp for the Tremont Canal & Power Company, of Nebraska, with a capital of $4,000,000, in which several influential Westerners are interested, for power transmission purposes to Omaha and other cities.

BIDS FOR WATER WHEELS.—The Great Northern Power Company, Duluth, Minn., will receive bids for three water wheels for its power plant, the wheels to drive an equal number of generators. Wheels of the vertical type will be used. Bids for electrical machinery will be invited later.

General News.

THE TELEPHONE.

GLOBE, ARIZ.—Arrangements have been made by the Gila Valley & Globe Telephone Company to extend its line from Globe to Livingstone and there to connect with the United States government telephone line which the engineers of the geological survey will build to Phoenix.

RUSSELLVILLE, ARK.—The Russellville Telephone Company, with a capital stock of $10,000, has been incorporated by R. M. Drummond, Wm. Rowan, A. Bernard and R. C. Brown.

MALVERN, ARK.—The Malvern City Telephone Company, with a capital stock of $8000, has been chartered. The incorporators are W. H. Cooper, H. A. Butler, Louis Myers, T. P. Frisby, A. M. Duffle, M. M. Duffle, D. C. Butler and J. M. Williams.

SAN DIEGO, CAL.—The Sunset Telephone & Telegraph Company has decided to extend its line from this city across the desert to the Imperial country, near the mouth of the Colorado River. This is part of a plan to extend to Tucson and Phoenix, Ariz. Twenty miles of the line, between San Diego and Ramona will be constructed at once.

ROBERTS, ILL.—The Lyman Telephone Company, of Roberts, has been incorporated with a capital stock of $5000, by Chris. Anderson, F. S. Diller and G. W. Madden.

SAYBROOK, ILL.—The Arrowsmith Telephone Company has been incorporated; capital, $1200. The incorporators are Charles W. Hurst, James A. Taylor, Walter Johnston.

YORKTOWN, ILL.—The Hoopole, Yorktown, Tampico & Thomas Telephone Company has been incorporated; capital, $4900. Incorporators: F. E. Toy, William Thomas, Thomas Burton.

LOVINGTON, ILL.—A 150-drop Stromberg-Carlson board is operated by the Gregory Telephone Company. Mr. C. A. Gregory reports 120 subscribers and 50 miles of toll line, the subscribers paying from $15 to $24 per annum.

FRANKLIN, IND.—The Franklin Telephone Company is considering a proposition to issue bonds for improvements to the plant.

ANDERSON, IND.—The Central Union Telephone Company has leased fifteen rooms on the fifth floor of the Union block in Anderson and an entire new outfit will be installed.

COLUMBIA CITY, IND.—Five hundred farmers in Whitley County have secured a franchise for an independent telephone company in this city and county. This action is a result of a disagreement with the Home Telephone Company as to rates. The capital stock is $25,000. The officers are: President, R. R. Scott; vice-president, C. R. Stoner; secretary and superintendent of construction, John C. Pence; treasurer, C. R. Banks.

SOUTH BEND, IND.—The Home Telephone Company of this city has opened a branch exchange in North Liberty with nearly 50 telephones. The company is constructing new rural lines in German township and has already connected 40 farmers with the South Bend exchange. Early in the Spring a metallic toll line will be constructed between Bremen and Plymouth. The company is increasing its patrons at the rate of 50 per month.

PRINCETON, IND.—The directors of the Princeton Independent Telephone Company have elected officers as follows: President, R. H. Parratt; secretary, C. F. Stevens; treasurer, J. W. Ewing. The company now has connections with 2300 telephones in Gibson County, of which 550 are in Princeton, the other main exchanges being at Owensville with 420 subscribers; Fort Branch and Hambstadt 400 each, and Frisco with 320. New exchanges are being installed at Patoka and Hazleton.

BLOOMFIELD, IA.—The Citizens' Mutual Telephone Company has been incorporated here.

PALMER, IA.—Rural telephone lines are projected to Pomeroy, Pocahontas and to the Lizard settlement. Mr. P. E. Tall is interested.

DES MOINES, IA.—The American Telegraph & Telephone Company, which was recently incorporated in Waterloo for $1,000,000, is now constructing a line between Waterloo and this city.

HOPKINSVILLE, KY.—The Hopkinsville Home Telephone Company, of Christian County, has been incorporated with a capital stock of $100,000.

JACKSON, MICH.—The Oceana Telephone Company has increased its capital stock to $200,000.

CANANDAIGUA, MICH.—The Northwestern Telephone Company has been incorporated with a capital stock of $1400.

LAKE CITY, MICH.—The Swaverly Telephone Company, of Kalkaska, has sold its system in Missaukee County. A new company will be organized to operate the plant. Many improvements are contemplated.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company has filed a trust mortgage with the Luzerne County Trust Company of Wilkesbarre, Pa., to secure an issue of $250,000 in bonds. The company is planning to build an exchange and expects to start with about 1200 subscribers.

FARIBAULT, MINN.—The City Council has granted a franchise to the Tri-state Telephone Company giving the latter the right to carry its lines through this city.

ALBANY, MO.—The Albany Telephone Company is a mutual enterprise. The rates for business houses is $1.50 per month, and for private residences $1. The company employs apparatus of American make, the switchboard having 400 drops, 300 of which are wired. Mr. J. B. Foster is secretary.

KANSAS CITY, MO.—The work of reconstructing the system of the Missouri & Kansas Telephone Company has been completed. Within the past eighteen months this work has required an expenditure of $750,000. The recent fire in the exchange in this city cost the company nearly $250,000. The reconstructed system is modern throughout.

BUFFALO, N. Y.—The Commercial Telephone Company has been incorporated with a capital stock of $50,000 to do business in Erie and Cattaraugus Counties.

STEELE, N. D.—Mrs. E. Allshouse has been granted a franchise for a local telephone exchange.

PORT JEFFERSON, N. Y.—The North Shore Telephone Company has been incorporated with a capital stock of $7500. The incorporators are A. B. Copley, Ralph J. Hawkins, F. H. Tuthill and Charles A. Squires.

ADA, OHIO.—The Ada Telephone Exchange Company has purchased the Dunkirk exchange. It operates an "American" 100-drop switchboard.

BRILLIANT, OHIO.—The Ohio Valley Telephone & Telegraph Company has been incorporated with a capital stock of $20,000. Directors: J. G. Gilchrist and others.

CANTON, OHIO.—The Stark County Telephone Company is installing additional switchboard and cables which will increase the capacity to 4000 lines. The company started business in March, 1902, with 1900 subscribers and now has nearly 3000.

NORTH LIMA, OHIO.—The Beaver Telephone Company is preparing to extend its system throughout Springfield township. The company has about 200 subscribers in North Lima and has connection with the lines of both the Youngstown Telephone Company and the Columbiana County Telephone Company.

CLEVELAND, OHIO.—The United States Telephone Company is planning to spend half a million dollars on improvements during the coming year. The company expects to carry its trunk lines into new territory and a great many additional wires will be strung on the trunk lines already in operation. The company now has about 18,000 miles of wire, nearly all in Ohio, and it is expected that about 8000 additional miles will be put up. Wires now running from Cleveland to Akron, Toledo, Columbus and Youngstown are leased to parties for telegraph service as well as for telephone service and the company aims to extend this double service throughout its entire territory.

WHITE LAKE, S. D.—The citizens of this place are arranging to establish a telephone system.

HURON, S. D.—The Dakota Central Telephone Company announces that it has perfected arrangements for the expenditure of $150,000 for the extensions in the southern and central portions of the state.

STANTONVILLE, TENN.—The Stantonville Telephone Company has increased its capital stock from $3000 to $10,000.

NASHVILLE, TENN.—The Roaring Fork Telephone Company has been incorporated with a capital stock of $250. Directors: J. K. Hardin, J. N. Holbrook and others.

COLUMBIA, TENN.—The Citizens' Telephone Company is run on the cooperative plan. The company operates a 400-drop board at Columbia and a 100-drop board at Mt. Pleasant, having a total of 530 subscribers. The charges are $1.95 for business service and $1 per month for residences. Mr. C. J. Porter is general superintendent.

HALLETTSVILLE, TEX.—A new telephone line is being constructed from this place to the towns of Ezzell and Creole.

SHERMAN, TEX.—The Long Distance Telephone Company has completed connection between Sherman and Oklahoma City.

EL PASO, TEX.—The Southwestern Telegraph & Telephone Company has announced through General Manager J. E. Farnsworth, of Dallas, that it contemplates expending about $100,000 in improvements of its El Paso system. It will erect an exchange building, place its wires underground, install a flash light switchboard, etc.

SMITHVILLE, TEX.—The Smithville Telephone Company has been organized here with a capital stock of $10,000. The officers are: President, H. C. Schumacher; vice-president, V. S. Robb; secretary and treasurer, J. M. Moore. The new company has acquired the telephone system which was owned by A. L. Hills & Son, and will make extensive improvements.

SAN ANTONIO, TEX.—At the annual meeting of the board of directors of the San Antonio Telephone Company, the following-named officers were elected: President, H. M. Daugherty, Columbus, Ohio; vice-president, H. M. Aubrey, San Antonio; secretary and general manager, D. A. Walker, Columbus, Ohio; superintendent, A. L. Beze, San Antonio; treasurer, Ferdinand Herff, Jr., San Antonio. It is stated that considerable rebuilding work and extensions will be made during the coming year.

SALT LAKE CITY, UTAH.—Manager D. S. Murray, of the Rocky Mountain Bell Telephone system, states that the company proposes to spend a large amount of money during the coming year in extensions and the general improvement of the system. The amount expended during the present year in improvements was $355,000.

MIDDLEBURY, VT.—The Rutland County Telephone & Telegraph Company has connections with Wallingford, Plymouth, Middletown Springs, West Pawlet and Danby, and has 118 subscribers. The company has 67 miles of toll line, its charges being $12 a year.

LONG GLADE, VA.—The owner of the exchange at this place, Mr. J. T. Ewing, informs us that it has 64 subscribers, and that a great many small exchanges will be put up in the future.

WHEELING, W. VA.—The Belmont Telephone Company has decided to make extensive improvements to its service in this vicinity.

BUCKHANNON, W. VA. An injunction has been granted the Buckhannon Telephone Company to restrain the Buckhannon Light & Water Company from building its lines closer than 10 feet to the telephone company's wires.

HINTON, W. VA.—A line to connect Hinton and Beckley, about 26 miles, is under consideration by the West Virginia Telegraph & Telephone Company. At Hinton there are 289 subscribers. The company owns 210 miles of toll line which was practically all built in the last four years.

FAIRMONT, W. VA.—The system of the Consolidated Telephone Company embraces 13 exchanges and numbers 2200 subscribers. At Fairmont, with 500 patrons, a Kellogg board of 700 drops has been installed. A line from Fairmont to Waynesburg is under consideration. The rates are $30 and $20.

HILO, EAST HAWAII, H. I.—The Hilo & Hawaii Telephone & Telegraph Company has 347 subscribers. There are four telephone companies on the island, each in its own separate district; no conflicting of interests. The island is completely covered with the service. The rate in the Hilo district is $4 a month; in the others $6. Subscribers in any district have unlimited switching and use of telephones in any other district. The Hilo Company uses metallic circuits; the other companies grounded circuits. All of the islands are connected by wireless system of telegraphy. Mr. E. E. Richards is manager of the Hilo & Hawaii Company.

OTTAWA, ONT.—The civic telephone committee of the city of Ottawa has recommended the granting of a franchise to the new Canadian Telephone Company. The main terms of the proposed agreement are that the company shall have a franchise for 21 years; that it shall pay $2500 annually to the corporation; that the rates shall not exceed $36 for office telephones and $32 for telephones in private houses. A deposit of $5000 is to be made by the company as a guarantee for the satisfactory carrying out of the agreement, and 40 telephones are to be given free to the city. The franchise will not be an exclusive one. Mr. F. Leonard, of New York, represented the company before the committee.

ELECTRIC LIGHT AND POWER.

BENTON, ARK.—The Electric Power & Ice Company, of Benton, has been incorporated with a capital of $5000. E. Y. Stinson, president; W. C. Caldwell, secretary.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company is stated to have secured the contract for lighting the city at $7.25 per lamp per month.

DURANGO, COL.—The Ute Land, Light, Power & Water Company has been incorporated with a capital of $100,000 by T. C. Graden, R. E. Sloan, A. L. Pace, Thos. A. Rucker and others, of Durango, as directors.

ATLANTA, GA.—It is repofted that $600,000 will be expended within the next few months by H. M. Atkinson and those interested with him in improvements to the Georgia Railway & Electric Company, the Atlanta Gas Light Company and other enterprises with which these men are connected.

TALLULA, ILL.—S. J. Culbertson, of Vandalia, Mo., is interested in the construction of an electric light plant.

VENICE, ILL.—This city will be equipped with a new electric light service by the Granite City & Venice Light Company by January 1. Lights will be kept burning all night.

JOLIET, ILL.—By winning a condemnation suit, the sanitary district trustees have procured all the land needed for building the water power extension of the sanitary canal.

FAIRMOUNT, IND.—C. T. Parker, W. H. Lindsay and others are interested in the construction of an electric light plant, to cost about $150,000.

ANDERSON, IND.—The city electric light board announces that it will start the new municipal electric lighting plant Dec. 20. It has been remodelled at a cost of $80,000, and includes many improvements, among which is a steam turbine to drive the generators.

PLAINFIELD, IND.—The Public Service Company has been organized and incorporated for the purpose of building and operating an electric light plant and a water works system in this city. The company has a capital stock of $50,000. Wm. B. Vestal and Sanders Hubbard are officials.

SHOALS, IND.—A business meeting of the directors of the Indiana Hydraulic Company was held last week and plans and specifications for two dams and as many power-houses were passed on by the directors. The plan of the managers is to erect two dams in White River near this city and supply electric power for interurban railroads and for small surrounding towns from the power-houses they will erect. The directors of the company are Jerome Herff, Peru, president and manager; Joseph Andrews, J. M. Bergman, William Hart and W. A. Gallup, of Vincennes.

SALINA, KAN.—W. D. Whited, of Denver, Colo., has purchased the plant of the Salina Light, Heat and Power Company and will rebuild the entire plant. He will also construct a railway in Salina.

COVINGTON, KY.—The Suburban Electric Light Company has brought suit to prevent the city from building or operating an electric light plant of its own. The citizens have voted to issue $75,000 in bonds for the purpose of building a municipal plant.

DERIDER, LA.—The Derider Ice, Light & Water Company has been organized here with a capital stock of $50,000 for the purpose of installing an electric light, water works and ice manufacturing plant. W. O. Brice is president of the company.

ALPENA, MICH.—The Alpena Gas Light & Heat Company has been incorporated with a capital of $100,000.

ST. IGNACE, MICH.—Geo. D. Westover, of Cadillac, has submitted a proposition to install an incandescent lighting plant at St. Ignace.

MINNEAPOLIS, MINN.—The State Board of Control is preparing to expend about $10,000 in improving the heating and electric light plants at the State University.

FARIBAULT, MINN.—The Consolidated Gas & Electric Company, of this city, has been re-organized under the name of Consolidated Gas & Electric Lighting Company.

LIVINGSTON, MONT.—The electric light plant in this city was recently almost completely destroyed by fire, the loss being about $15,000, which is covered by insurance. New machinery has been ordered and will be installed as soon as possible.

JOPLIN, MO.—It is reported that about $30,000 will be expended for improving the electric light plant.

KIRKLAND, N. Y.—The Kirkland Electric Company, of Kirkland, has been incorporated with a capital of $100,000. Directors: J. F. Wood, of Clinton, and H. B. Sweet, Utica.

ALBANY, N. Y.—The State Civil Service Commission announces examinations on Jan. 9 for various positions, including an assistant electrical engineer. Application must be made before Jan. 4 to the Chief Examiner of the Commission.

LOUISBURG, N. C.—Bids are wanted Dec. 21 for $65,000 light and water bonds.

SCOTLAND NECK, N. C.—The town commissioners have closed a contract with the Standard Electric Company, of Norfolk, Va., for the installation of an electric light plant.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company has obtained a 25-year franchise to operate an electric lighting system in the city of Mansfield.

BARBERTON, OHIO.—The council has granted a 10-year franchise to O. C. Barber and associates to furnish electric light throughout the town. The company will erect a plant at once.

EAST LIVERPOOL, OHIO.—The American Sewer Pipe Company is installing an electric power plant in its works here for the purpose of illuminating the shops, supplying power for machinery and for operating electric drills used in mining clay.

DELHI, OHIO.—H. Platt has completed plans for the erection of a lighting plant for the purpose of furnishing power and light for the villages of Delhi, Home City and Fernbank. The matter has been under consideration for some time and the plant will now probably be built.

DELAWARE, OHIO.—The plant of the Electric Light, Heat & Power Company was damaged by fire to the extent of about $2000 recently. The fire was confined to the boiler room and some of the boilers were badly damaged. The city arc light system was interfered with for a short time. The plant will be repaired.

ATHENS, OHIO.—The Erner-Hopkins Company, Columbus, Ohio, has secured a contract for the erection of a municipal electric lighting plant at Athens, including a brick building, a 300-hp boiler, a 250-hp engine, a 150-kw generator and auxiliary equipment. The plant is to furnish 80 arc lamps and 2000 incandescents.

BRYAN, OHIO.—A new swindle is being perpetrated on farmers in Fulton County, Ohio. Two men have been soliciting business from farmers and offering to install, at a low figure, an electric light plant, that will light a house and barn for twenty years without repairs or battery renewals. A contract is signed which makes the farmer liable for almost any amount on a promissory note.

CLEVELAND, OHIO.—The Central Heat, Light & Power Company, of Cleveland, have been incorporated with $10,000 temporary capital stock by H. W. Jones, G. G. Whitcomb, H. H. Johnson, F. B. Williams and George H. Kelly. The company proposes to erect a central station in the down-town district of Cleveland to supply light and power to a number of merchants and manufacturing establishments.

GUTHRIE, O. T.—Manager Garfield, of the Electric Light Company, is in favor of constructing a new electric light plant which would probably cost about $70,000.

WYALUSING, PA.—A franchise has been granted to the Wyalusing Light & Power Company to furnish street lighting. F. N. Davis is general manager.

ORANGE, TEX.—S. C. Tremble, of Hillsboro, has acquired a large interest in the Orange Ice, Light & Water Company and it is reported that extensive improvements will be made in the electric light plant.

WARTRACE, TENN.—The question of constructing an electric light plant is under consideration here.

NEWPORT NEWS, VA.—The city authorities are considering the matter of bonding the city for $200,000 for the erection of an electric light plant.

BUCHANAN, VA.—Mr. O. E. Obersshain, president of the Batetourt Telephone Company, Buchanan, and associates are contemplating building a dam across the James River at this point to develop 2000-hp for electric light and power.

BLOOMER, WIS.—Rasmus and Christiansen, proprietors of the electric light plant here, have installed a new system and derive their power from a waterfall at Eagle Point, seven miles from town.

ALAMOGORDO, NEW MEX.—S. E. Pelphrey, who has the contract for the construction of the new electric light and power plant at this place has begun work.

WINGHAM, ONT.—The town has voted $28,000 bonds to purchase the electric light plant.

OTTAWA, ONT.—The Erie & Ontario Development Company, of Welland, Ont., has been chartered with a capital of $90,000 to develop electric and water power. Mr. D. W. Allen, of Buffalo, N. Y., is one of the promoters of this enterprise.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—Dr. H. J. Reynolds, of Columbus, Ohio, is one of the promoters of an electric railway to be built between Huntsville and Nashville.

EUFAULA, ALA.—The Eufaula & Abbeville Electric Railroad Company has been incorporated at Eufaula. A line 28 miles long, between Eufaula and Abbeville, is to be constructed. The incorporators are J. B. Foy, B. B. McKenzie, R. A. Ballowe, C. A. Martin, H. C. Holleman, L. H. Braswell. A light and power plant is also proposed.

GRANGEVILLE, IDA.—A meeting has been held here at which a committee was appointed to look into the advisability of constructing an electric street railway system. Secretary Randolph, of the Lewiston & Southeastern Railroad, is the chief promotor of the project.

WOODRIVER, IDA.—The Carbonate Hill Mining Company has decided to build an electric railway from Ketchum to Stanley Basin, a distance of about 60 miles. There is a great deal of traffic between the two points, and the company expects to use the road for hauling its ore and supplies between the railroad and its mines.

SPRINGFIELD, ILL.—The Illinois Central Traction Company has been incorporated; capital, $1,000,000; to construct a road from Decatur, Macon County, to Springfield, Sangamon County, Ill. The incorporators and first board of directors are W. B. McKinley, Charles Zilly, B. R. Stephens, F. H. Hahn and H. J. Pepper, all of Champaign, Ill.

NEW ALBANY, IND.—It is announced that the Louisville & Southern Indiana Traction Company has acquired an option on the Highland Railway Company's property.

INDIANAPOLIS, IND.—The officials of the newly incorporated Columbus, Grensburg & Richmond Traction Company announce that contracts to build the line, power house and shops will be made this winter, work to begin in early spring.

MADISON, IND.—It is announced that the Southern Traction Company, of Indiana, represented by Messrs. Hubbard, Yoder and Rominger, of Indianapolis, has purchased the plant and property of the Madison Light & Railway Company, of Madison.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company has decided to equip the line with double tracks and the third-rail system. From Indianapolis to Cincinnati in three hours is the time the officials promise to carry passengers, a schedule faster than that of the steam roads.

RUSHVILLE, IND.—The directors of the Indianapolis & Cincinnati Traction Company have decided to enlarge the power house under construction here sufficiently to give room for another battery of boilers. This will give the company much more power, making the total energy available under present plans about 4000 hp. This increase was made necessary by reason of having purchased the Shelbyville line.

CAMDEN, ME.—Editor D. N. Thayer, of the Rockland, Me., *Star*, writes under date of Dec. 3 that while the survey of the newly proposed 18-mile trolley line from Camden to Belfast has been practically completed by W. B. Getchell, chief engineer, who resides in Augusta, no estimates for the construction contracts or equipment has been asked for as yet and in fact been considered by the directors, no meeting having been held for such a purpose. It is not believed that the road can be completed or in full operation before the latter part of next year at the earliest.

PITTSFIELD, MASS.—President Gellett, of the Berkshire Street Railway Company, announces that his company is ready to build an electric railway from Pittsfield to Lenox, if suitable locations on the highway can be secured.

WILLIAMSTOWN, MASS.—The Hoosac Valley Street Railway Company has filed a petition with the Selectmen of Williamstown, asking for locations from the terminus of its present line to the Massachusetts-Vermont State line. The proposed extension is to be a part of the line to Bennington, Vt., and Troy, N. Y., and would provide street car service for Westonfield, Williams College. A petition, asking that the franchise be not granted has been circulated.

BATTLE CREEK, MICH.—The Grand Rapids & Southern Michigan Traction Company, which was incorporated last June with a capital stock of $1,300,000, will soon be prepared to consider propositions for the handling and sale of its bonds.

VIRGINIA CITY, MONT.—A company has been organized here for the purpose of building an electric railway connecting the Ruby Valley with Dillon and the Oregon Short Line. A power plant will be established somewhere along the route of the proposed line.

ST. LOUIS, MO.—Contracts have been let by the Imperial Transit Company, of St. Louis, for an equipment of 30 automobile electric busses, which, during the World's Fair period and after, are to transport passengers to and from the World's Fair grounds. The Western Electric Company will furnish the motors. The busses are to be built by the American Car Company. The new company is to be managed by Thomas M. Jenkins, formerly general manager of the St. Louis & Suburban Railway Company, who is also president of the new corporation. The company is capitalized for $600,000. The automobile busses are to be run on a "no seat, no fare" basis."

LINCOLN, NEB.—The Lincoln Traction Company's property, comprising practically the entire street car system of the city, was sold at auction Dec. 1 in foreclosure proceedings to satisfy a tax lien of the city of Lincoln. Charles A. Frueauff, a stranger, bought the property on a bid of $1,160,000.

JERSEY CITY, N. J.—The Public Service Corporation has decided to order fireproof cars for the tunnel under the Hudson River, now nearly completed. The tunnel referred to consists of two parallel tubes, each of which will accommodate a single trolley track. The entire length of the tunnel from the foot of Thirteenth Street, Jersey City, to Morton Street, on the New York side, is 9200 ft., and of this distance 5600 ft. are under water. The depth of the tunnel from the surface varies from 60 ft. at the water's edge on both sides to 100 ft. in the center. The company is sanguine that the tunnel will be ready for passengers by Jan. 1, 1905.

NEW YORK, N. Y.—The Interurban Street Railway Company has replaced the old horse cars on the Fourteenth Street lines with up-to-date cars of the electric conduit type. The change is greatly appreciated by the numerous women patrons of the roads in question, who frequent that shopping district.

MANSFIELD, OHIO.—The promoters of the proposed Mansfield & Mt. Vernon Railway are securing estimates on the cost of electrical equipment for the proposed line.

CORTLAND, OHIO.—C. G. Phillips, of Cortland, is promoting an electric railway from Jefferson to a point on the proposed Cleveland & Sharon Railway. This line, if built, will form direct connection from Cleveland to Jefferson.

DAYTON, OHIO.—The Dayton & Kenton Traction Company has completed arrangements for refinancing the project, and it is stated that a contract has been closed whereby construction work on the line will start at once.

WAUSEON, OHIO.—The Ohio Northern Traction Company, capital stock $10,000, has been incorporated by H. C. Coy, W. W. Campbell, C. E. Bennett, S. A. Wright and D. K. Shoop. The company proposes to build an electric railway from Defiance to Wauseon.

DAYTON, OHIO.—The Dayton & Germantown Traction Company has changed its name to the Dayton, Germantown & Middletown Traction Company. Considerable work has been done on the line, and it is now planned to build an extension to Middletown. J. O. Arnold is president of the company.

COLUMBUS, OHIO.—Surveys have been completed for the extension of the Columbus, New Albany & Johnstown Railway, and it is probable that construction work will be started this winter. At present Johnstown is 60 miles from Columbus by steam road. The route by the electric road will be 27 miles long.

CLEVELAND, OHIO.—A resolution has been passed by the City Council providing for the erection of seven shelter houses in various portions of the city. All of the corners are important transfer points on the lines of the Cleveland Electric Railway Company. The city erected two such shelter houses on the Public Square about a year ago.

READING, PA.—The Allentown & Reading Traction Company has secured the right of way for its new branch between Lyons and Alburtis. The construction of the line will be begun in the spring.

BLOOMSBURG, PA.—All the right of way for the Danville-Bloomsburg Electric Railway has been secured, and actual construction work will be commenced early in the spring. Contracts have been awarded and material will be delivered during the winter.

JACKSON, TENN.—Prominent citizens of Jackson have secured a charter for a railroad from Jackson City to Kansas City, Mo. The charter provides that it may be operated by steam or electricity. The capital stock is $2,000,000. The incorporators are Judge H. W. McCorry and Rush A. Persons.

MEMPHIS, TENN.—The development of the Shelby County Traction Company's project to build an interurban railway from Memphis to Collierville, a distance of 25 miles, is now on in earnest. I. B. Hudson, general manager; Lewis S. Proctor, consulting engineer, and J. A. Omberg, chief engineer, are examining the country between the two places to determine upon the most advantageous route.

RICHMOND, VA.—There is a movement on foot to build an electric railway from Richmond to Urbana, a distance of 50 miles. The proposed route is now being surveyed. John C. Robinson is interesting capital in the enterprise.

NORFOLK, VA.—The stockholders of the Chesapeake Transit Company have increased its capital to $1,000,000. The company, which operates a trolley line from Norfolk to Lynn Haven Inlet, Cape Henry and Virginia Beach, proposes to make an extensive improvement by next summer, which will include the double-tracking of the entire line, a distance of 24 miles.

WALLA WALLA, WASH.—The Northwestern Gas & Electric Company has under contemplation, it is reported, the building of an electric railway system here. An electric plant will also be erected on the Walla Walla River.

MILWAUKEE, WIS.—The Milwaukee Heat, Light & Traction Company has begun condemnation proceedings for the extension of its line from Hale's Corners to Muskego Center. This extension calls for about 6 miles of track.

GUAYMAS, MEX.—G. A. Albert, of Utica, N. Y., is at the head of a project to build an electric railway from this place across the Sierra Madras to the city of Chihuahua, Mexico, a distance of about 300 miles. He claims to have made considerable progress in the preliminary arrangements for the enterprise. It is stated that the road will pass through a rich mineral country. Application will be made to the Mexican government for a concession for the enterprise.

ST. THOMAS, ONT.—The first year's working of the electric street railway, of the city of St. Thomas, Ont., as a municipal service, has resulted in a practical balancing of the accounts. This showing, in view of the fact that the whole system has been transformed into an up-to-date one, is considered very satisfactory.

OTTAWA, ONT.—The proposed electric railway between Toronto and Ottawa, by way of Kingston, which has been in contemplation for the past two years, will soon begin to take form. The company proposes, also, to furnish cheap electricity for power purposes thereby booming manufacturing industries in the towns and cities through which its line will pass. Mr. A. E. Pard, of Boston, Mass., is interested.

MONTREAL, QUE.—An electric railway is projected on the north shore between Montreal and Ottawa. Among the promoters are: Thos. Christie, J. A. C. Ethier, F. O. Dugas, Senator Domville, Kings, N. B.; J. D. Wells, Toronto; W. A. Weir, Hon. Mr. Mathieu. A meeting of the shareholders for the purpose of electing a board of directors will be held on Jan. 12.

LEGAL.

THE LOCHE INSULATOR COMPANY, of Indianapolis, Ohio has filed a petition for an injunction against the New Lexington High Voltage Porcelain Company, of New Lexington, Ohio, claiming that the latter has infringed on certain insulator patents. The company wants an accounting and damages.

WESTERN UNION TELEPHONE ROYALTY.—The American Telephone & Telegraph Company has decided not to ask for a rehearing before the United States Court of Appeals in the Western Union-Bell Telephone royalty case which was decided in favor of the plaintiff Oct. 7, last. Counsel for the American Telephone Company has notified counsel of the Western Union Telegraph Company to that effect. It appears that the American Telephone Company was given thirty days in which to petition for a rehearing, which was extended by consent of the plaintiff to Dec. 4. The next step in the case will be the appointment of an auditor by the court to determine the payment to be made by the American Telephone Company, or a petition for a writ of certiorari for a trial before the Supreme Court.

DALLAS, TEX.—T. L. Marsalis, formerly of Dallas, but now of New York City, has filed suit in the Federal Court for the northern district of Texas against the Northern Texas Traction Company owners of the Dallas & Fort Worth Interurban Railway, for one-tenth of all the stock and bonds, aggregating $3,500,000, or in lieu thereof $200,000 in money. The suit is based on contracts claimed to have been made between Marsalis and George T. Bishop and associates, a syndicate of Cleveland, Ohio, capitalists, who organized the Northern Texas Traction Company and built the interurban road. Mr. Marsalis says he was the original projector of the road and that Bishop and his associates took over the enterprise and then violated their contracts.

PERSONAL.

PRESIDENT HENRY A. BARNHART.

HENRY A. BARNHART, the newly elected president of the Inter-State Independent Telephone Association of America, is president of the Rochester Telephone Company, and editor of the *Sentinel*, at Rochester, Ind. He was born near Logansport, in 1858, and has lived in Rochester for twenty years. Mr. Barnhart has been active in state politics; has served on the Board of Control of the Northern Indiana State Prison and Northern Indiana Hospital for the Insane, and is quite prominent in state charities and corrections. His activity in the independent telephone field is well known, and has again been exemplified during the recent convention held in Chicago, where Mr. Barnhart played an important part in the proceedings and was appointed on committees dealing with vital topics before the body. He is in the prime of life and appears destined to become even more conspicuous in the social and political life of Indiana, a state which from the first has led in the independent telephone movement.

MR. GEORGE BULLOCK, president of the Bullock Electric Company, of Cincinnati, Ohio, was a visitor in New York for a few days last week.

MR. HARRY ALEXANDER, the electrical engineer, has returned to his offices in the Astor Court Building, after an extended trip around the world.

MR. A. T. RALPH, formerly of the Cincinnati, Ohio, works of the Bullock Electric Company, has been appointed assistant manager of the New York office in the St. Paul Building.

PROF. RUTHERFORD, of McGill University, one of the foremost living scientists, has written an interesting article on "The Disintegration of the Radio-active Elements" for the January number of *Harper's Magazine*.

MR. C. O. HARRIS, formerly superintendent and engineer of the Rochester, N. Y. Telephone Company, has associated himself with the sales department of the Stromberg-Carlson Telephone Mfg. Company, and is now located in Chicago.

GEN. F. V. GREENE.—It is announced from Buffalo that Gen. Francis Vinton Greene, Police Commissioner of New York City, has accepted a position with the Albright-Hayes Power Company, which is building a power plant on the Canadian side of Niagara River at Niagara Falls, and will assume his new duties on Jan. 1.

MR. W. L. FAIRCHILD, formerly vice-president and secretary of the John F. Kelly Engineering Company, 149 Broadway, New York, is now attached to the sales department of the New York offices of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio.

MR. F. FENWICK, of Fenwick Freres, Paris, one of the largest handlers of American machine tools, etc., on the Continent, is now on a visit to the States. Before returning home Mr. Fenwick expects to place some substantial contracts. He has gone west, but will be in New York again early next week.

MR. ALFRED MOSELY, who headed and defrayed the expenses of an English commission that came here some months ago to study our educational system, returned to England last week on the steamship *St. Louis*. He expects good results for the effort that has been made to secure light here on the subject.

HON. JOSEPH CHOATE, U. S. Ambassador to England, delivered an address at Birmingham recently on Benjamin Franklin, which has attracted much favorable attention. It has been printed in full by the *New York Sun* and includes appropriate though not very extended reference to his work as an electrical pioneer.

MR. PETER COOPER HEWITT and Mr. S. Thomas lectured before the Technology Club of New York on Dec. 10. Mr. Thomas is a graduate of the Mass. Institute of Technology, and the local club is in flourishing condition as shown by the crowded and enthusiastic audience. The introductions were made by Mr. Calvin W. Rice.

MR. J. L. GREATSINGER, ex-president of the Brooklyn Rapid Transit Company, of New York; Peter Kimberly, the iron man of Sharon, Pa., and associates have proved up a valuable copper mine in the wilderness sixty-five miles west of Port Arthur, Ontario, and fourteen miles south of the Canadian Northern Road.

MR. JOHN W. GATES.—Mr. John W. Gates, the steel millionaire and speculator, who has an elegant Winter residence at Port Arthur, Tex., has become interested in the Beaumont, Sourlake & Port Arthur Traction Company, which proposes to construct an extensive system of interurban electric railway in this section. It will connect Port Arthur with the different oil fields.

PROF. ROBERT SIBLEY, recently graduated from the University of California, has accepted the chair of mechanical engineering at the University of Montana. Prof. Sibley founded and was first editor of the *California Journal of Technology*, published at the University of California, and was one of three students appointed to welcome President Roosevelt upon a visit last May to the University.

DR. D. C. GILMAN.—President Daniel C. Gilman, of the Carnegie Institute has notified the trustees that he proposes to resign at the end of next year. He states that he makes his purpose known now so that they may not be taken unexpectedly. Dr. Gilman was elected for five years, and has served two years. He gives as his reason for resigning his advancing years, which make the burden of his position very onerous to him.

MR. CHARLES T. YERKES is apparently looking forward to making more of a regular home in New York for he has just bought a house adjoining his own on Fifth Avenue and Sixty-eighth Street, intending to remove it and extend his residence, which will thus become one of the largest and most prominent along the Park. The other corner is occupied by Mr. W. C. Whitney and Mr. George Gould's house is on the corner of Sixty-seventh Street.

MR. H. HINE, formerly of the Stanley interests, and now president of the Guanajuato Electric Light & Power Company, Mexico, which concern recently completed the second longest power transmission system in this hemisphere, is now in New York. His visit here is made in connection with the project of the company to build a large plant at Zitacuaro for the purpose of developing power for transmission to the El Oro mines. He is a guest at the Waldorf-Astoria. Down-town he is making his headquarters at the offices of the Western banking house of William P. Bonbright & Company, 15 Wall Street.

MR. C. CURRIE.—At Canton, Ohio, on December 11, Mr. Henry Everett's private trolley car with Mr. and Mrs. Charles Currie and Dr. and Mrs. O. M. Lyon, all of Akron, as passengers, was wrecked. Dr. Lyon was gravely hurt, while Mrs. Lyon received injuries that may prove serious. The car was approaching the city at a lively rate, and the motorman applied air some distance before the switch with the Akron line was reached, but the wheels slipped on the rails, and the front trucks left the track and struck a telephone pole, knocking it down and battering in the end of the car. Mr. Currie is general manager of the Northern Ohio Traction Company, and was going to the city on a pleasure trip.

PROF. MORRIS LOEB, of the department of physics at the New York University, who is well known in New York electrical and technical circles, has sustained an irreparable loss in the death of his father, Mr. Solomon Loeb, one of the founders of the banking firm of Kuhn, Loeb & Company, and a large owner of real estate. Mr. Loeb was active in commercial and charitable work of all kinds. He was a director for many years of the Mount Sinai Hospital, and was one of the founders of the Provident Loan Society, of which he continued an active director till the time of his death. He was also a member of the American Museum of Natural History, the New York Botanical Gardens, and the Metropolitan Museum of Art.

MR. C. F. PILLSBURY, of Minneapolis, at the annual banquet of the Minneapolis Retail Dealers' Association, described the construction and operation of electric light plants. He cited figures from the statistics of plants in operation, considered the cost of production per kilowatt as compared with the price which the consumer pays, and also cited the price at which the product should be sold in order to return a fair profit on the investment. Mr. Pillsbury spoke for four hours, and later answered the questions which were asked of him. Mayor Haynes and a committee of 15 aldermen who are at work on the proposed franchise, were among the guests and manifested much interest. A vote of thanks was extended to Mr. Pillsbury for his profitable and interesting speech.

MR. JOHN W. BROOKS.—We were able to note briefly last week the fact that Mr. Julian S. Jackson had become sales agent for Pass & Seymour, Inc., in Chicago, taking the place of Mr. John W. Brooks. The latter now becomes sales manager at Solvay, N. Y., headquarters. Mr. Brooks had been representing this well known porcelain product in Chicago for nearly six years and covered from that point a territory including some eighteen states. Prior to this connection, Mr. Brooks was with the Brooks-Follis Corporation, of San Francisco, so that his acquaintance with the electrical industries is of long standing. Under the new regime he will relieve general manager Salisbury of part of the work due to the rapid growth of the concern and will of course supervise the sales agencies throughout the country. Mr. Brooks is fully equal to the new responsibilities and in his larger and even more comprehensive sphere of action will have a better opportunity to display the sterling qualities that have made him so many friends and won for him so enviable a reputation all over the west. His association with Mr. Salisbury at headquarters should prove a further step in the widespread popularisation of the P. & S. product.

MR. WALTER H. WHITESIDE, the manager of the detail and supply department of the Westinghouse Electric & Manufacturing Company, has also been made the general manager of the Sawyer-Man Electric Company and has added the duties of this new office to his former ones. Few men are better known than Mr. Whiteside in the electrical business. He has been connected with electrical trade interests for nearly twenty years and during that time has extended his acquaintanceship to every part of the country and cemented friendships wherever he went. Mr. Whiteside became a special salesman for the Westinghouse Electric & Manufacturing Company in Chicago in 1898. A year later he was sent to Washington, D. C., to take charge of sales to the Government. This led, in 1900, to his being made manager of the company's office for that district, then having its headquarters in Washington. From the Washington office he was promoted to the management of the detail and supply department of the company, with headquarters at Pittsburg. Under Mr. Whiteside's management, the business of this department has greatly increased. Additional manufacturing facilities are being provided and a continued growth is expected.

PROF. W. E. GOLDSBOROUGH, of the department of electrical engineering at Purdue University and chief of the Department of Electricity at the Louisiana Purchase Exposition, gave a talk on "Electricity as a Factor in Expositions" before the Chicago branch of the American Institute of Electrical Engineers Dec. 8. Stereopticon views illustrated the talk and served to show the increasing application of electricity in expositions. Views of the expositions held in Paris, Chicago, Atlanta, Omaha and Buffalo illustrated the progress made in each successive one and served to convey an idea of the electrical features as they will be at the St. Louis Exposition. Three colors, yellow, amethyst and green will form the basis of the color and lighting scheme at the latter. The gradations in light caused by an increase or diminution in one or more colors at the same time, will permit of the illumination of the buildings and the grounds in a manner not attempted before. Another feature of the exposition will be three cascades, the water for which will be pumped by machinery operated by three 1000-hp motors. Fifty thousand horse-power will be available for power purposes in the power plant, which will include operating exhibits of various machinery, both of foreign and domestic manufacture. In fact, processes, instead of products, will give the exhibits distinguishing character at the exposition. Various articles, such as incandescent lamps, motors, etc., will be shown in continuous process of manufacture. The exhibits, wherever possible, will show machines in operation or manufacturing apparatus. The National Bureau of Standards will have a laboratory at the exposition, and a complete corps of assistants will be present to make tests. It is therefore hoped that all awards will be made on the basis of actual excellence. Many of the details noted by Prof. Goldsborough have already been treated in these pages.

NEW INDUSTRIAL COMPANIES.

THE VALENTINE GAS ENGINE COMPANY, of Westfield, N. J., has been incorporated; capital, $50,000. Incorporators: Warren P. Valentine, Charles Bates Dana, Frank A. Clay.

THE INTERNATIONAL ENGINEERING COMPANY, of Camden, N. J., has been incorporated; capital, $100,000. Incorporators: Luther D. Lovekin, Warren D. Peck, Frederick C. Eaton.

THE REMEY ELECTRIC MANUFACTURING COMPANY, of Anderson, Ind., has increased its capital stock from $10,000 to $50,000. B. P. Remey is president and Frank I. Remey, secretary.

THE CROUSE-HINDS COMPANY, of Syracuse, N. Y., has been incorporated to manufacture machinery; capital, $450,000. Directors: H. B. Crouse, J. L. Hinds and D. F. Costello, of Syracuse.

THE GENERAL LIGHTING SUPPLY COMPANY, of Philadelphia, has been incorporated to furnish light, heat and power, and manufacture and sell lighting supplies. The capital stock is $35,000.

THE BRUCKNER TELEPHONE & ELECTRIC COMPANY, of New York; capital, $15,000, has been incorporated. Directors: F. C. Bruckner and St. S. B. Gwynn, New York, and A. E. Hoecker, Brooklyn.

THE L. S. BRUENN COMPANY, of New York City, has been incorporated with a capital stock of $25,000 to manufacture electrical appliances. The directors are L. S. Bruenn, S. S. Rich and Alexander Ungar, New York.

OBITUARY.

ADMIRAL GHERARDI.—We regret to note the death of Rear Admiral Bancroft Gherardi, at Stratford, Conn. This well-known officer, who was the nephew of Bancroft, the historian, was navigating officer of the U. S. frigate *Niagara* at the time she assisted in the first submarine cable laying work in the North Atlantic. Mr. B. Gherardi, Jr., chief engineer of the New York & New Jersey Telephone Company, is a son of the late admiral.

MR. A. J. WISE.—It is with deep regret that we note that Mr. Albert J. Wise, of the law firm of Quackenbush & Wise, and president of J. H. Bunnell & Co., manufacturers of electrical supplies, died in New York City on Dec. 10. His death was due to bronchitis following internal injuries received the week before, when he slipped and fell near his home while alighting from a trolley car. Mr. Wise was born in Lima, Ohio, Sept. 24, 1869. He took the degree of LL.B. at Yale and afterward at Columbia University. After his graduation Mr. Wise practiced law for some time in his native town, but removed to New York in 1891. In 1896 he married Miss Gertrude Bunnell, daughter of Jesse H. Bunnell, the inventor and manufacturer, whence sprang his interest in the electrical industry. He was interested in yachting, owning the fine steam yacht *Chetolah*, and was a member of the New York Yacht, Atlantic Yacht and Sea Cliff Yacht Clubs. He was also inspector of public schools for the Boroughs of Manhattan and the Bronx. His wife survives him.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE.—The high potential transformer built by the electrical engineering department of the Worcester Polytechnic Institute in 1898 under the direction of Professor Harold B. Smith, the head of the department, has recently been sold to Mr. C. S. Knowles, of Boston, and has been sent by him to New Lexington, Ohio, for installation at that place. It will be used in connection with the high voltage porcelain works in which Mr. Knowles is interested. The transformer has already been installed and is now ready for testing work. The installation was performed by Messrs. J. A. Sandford and W. T. Goddard, assistants to Professor Smith in the electrical engineering department of the Institute. This transformer has, since it was built, been an object of considerable interest in electrical engineering circles, and inquiries have been received by Professor Smith respecting the details of its construction from all parts of the United States, and also from abroad. Its capacity is 150,000 volts, with a frequency of 60, and, as is well known, this is the first transformer ever built in which so high voltage was attained which could be successfully used for commercial purposes. The transformer was from the first entirely successful, and amply fulfilled the expectations entertained by Professor Smith when he first designed it. In searching for apparatus with which the necessary testing could be done, Mr. Knowles experienced great difficulty in obtaining satisfactory estimates from the different electrical companies; hence negotiations were opened with Professor Smith which finally resulted in the purchase of the transformer belonging to the Worcester Institute. It will be replaced immediately at the Worcester Polytechnic Institute by the construction of a new transformer which will contain a number of improvements. These have been devised during the experience of the electrical engineering department in high potential work during the last five years. Mr. Sandford will remain at New Lexington where he will be engaged for some time conducting a series of experiments involving the use of high potentials.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, sales agent for Packard lamps, Zenith "intermediate" lamps and Adams-Bagnall arc lamps, is out with a most complete line of new lamp literature. It is worth sending for by any one interested.

RADIUM.—*The Edinburgh Review's* highly important article on Radium which has been pronounced a most satisfactory and authoritative description of that element is reprinted as the leading article in *The Living Age* for December 5, occupying several pages of that interesting publication.

THE W. J. BARR MFG. COMPANY, Cleveland, Ohio, has issued a very interesting and instructive circular showing the different styles of transmitter arm which it manufactures. The illustrations are handsome half tones very clearly printed with just a word or two in reference to the superior quality of the work which the company supplies.

THE SAVAGE & LOVE COMPANY, Rockford, Ill., is bringing out a treatise on gas and gasoline engines which is contained in the catalogue of its gas engines now in the printer's hands. The catalogue of course speaks of its own engine, but contains a great deal of information in regard to gas engines in general which will be found very useful.

GRAPHITE SUGGESTIONS is the title of a handsome and interesting publication of the Joseph Dixon Crucible Company, of Jersey City, N. J. Many are the uses referred to. In the section devoted to electricity, various uses are spoken of, including graphite resistance in rods varying from 1 inch to 12 inches, as well as in other forms. A number of views show graphite made up for electrical purposes.

PANEL FUSES.—The Central Electric Company, Chicago, is sending out to the trade a circular calling attention to D. & W. panel fuses and their adaptability for use with Adams-Bagnall and other makes of arc lamps. A connector is shown by the use of which D. & W. fuses can be fitted to any arc lamp without the necessity of a fuse block. The members of the firm are enthusiastic over the increased volume of business they are doing on D. & W. material generally and state that the number of orders received is so great that they find it difficult to meet the demand.

AIR COMPRESSORS.—A new line of air compressors is described in Bulletin L-509, recently issued by the Laidlaw-Dunn-Gordon Company, of 114 Liberty Street, New York City. These compressors are fitted with Meyer steam-valve gears, permitting of an adjustable cut-off. The air ends are arranged both with poppet inlet and outlet valves and with mechanically operated inlet and poppet outlet valves, the valves in either case being placed in the head of the cylinder, permitting the body to be effectively water-jacketed. The frames of the compressors are specially heavy. The capacities listed range from 468 to 2220 cubic feet of free air per minute, and the air pressure from 80 to 100 lbs. per sq. inch. This pamphlet will be sent upon request to those interested.

THE MONTAUK FIRE-DETECTING WIRE recently proved itself remarkably efficient as a thermostat, by recording an alarm caused by an over-heated bearing in the establishment of Thomas Oakes & Company, woolen manufacturers, of Bloomfield, N. J. The low temperature at which this alarm was given enabled the employees of the company to extinguish the fire, without any serious results. This wire is practically a continuous thermostat, and can be so arranged as to give an alarm at high or low temperature, so that it can be carried through offices, stores, apartments, hotels, etc., where a temperature of 200° would mean the presence of fire, while the same circuit can be carried through the boiler and engine rooms, etc., where a temperature of 200° would not necessarily mean fire, and can be so arranged as to give the alarm in such over-heated places only when the temperature reaches the neighborhood of 400°. It can either be permanently affixed to the ceilings or walls, or it can be carried on reels on the walls, thus enabling the user to protect his goods by unreeling at night and laying the wires across his merchandise, and reeling it up in the morning. This is an invaluable adjunct to fire protection in dry goods and other stores.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 8, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

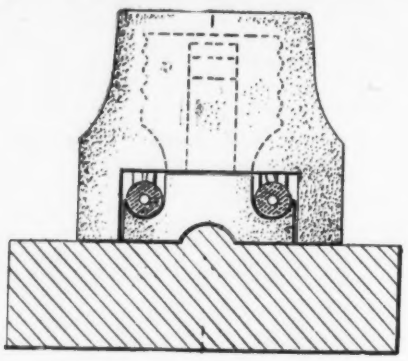
745,999. INSULATOR; Sigmund Bower, New York, N. Y. App. filed Jan. 21, 1903. A two-part insulator with an annular notched flange and a conical projection on one part, the second part fitting between the flange and projection.

746,018. HEATER FOR SWEAT BATH CABINETS; Terry O. Carman, East Liverpool, Ohio. App. filed Jan. 21, 1903. An electric heater placed under a chair to be located in a cabinet.

746,040. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed May 27, 1901. (See page 1008.)

746,047. AUTOMATIC REGULATOR; Austin R. Dodge, Schenectady, N. Y. App. filed Aug. 21, 1902. An electric motor geared to the throttle valve of an engine is controlled by a pressure gauge to automatically maintain a given steam pressure delivery to the engine.

746,050. ELECTRIC FUSE OR CUT OUT; Louis W. Downes, Providence, R. I. App. filed May 7, 1902. The fuse link is in the form of a tube, the invention extending to the construction of the end contacts and features for mounting in a tubular casing.



746,483.—Electrical Receptacle.

746,051. MOLD BOX FOR CONDUIT JOINTS; Eugene L. Du Bois, New Orleans, La. App. filed May 4, 1903. A metallic strap having side flanges and adapted to be placed around a conduit joint to receive the cement.

746,065. SELECTIVE TELEPHONE SYSTEM; Amos Gagnon, Stafford Springs, Conn. App. filed Nov. 8, 1902. (See page 1008.)

746,069. ELECTRICAL SIGNALING DEVICE; Herbert C. Giles, New York, N. Y. App. filed April 24, 1903. Details of a railway signal in which the train actuates certain contacts in the roadway to operate signals in the cab of another train.

746,074. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed Feb. 20, 1903. The field magnet current of a main generator is varied to give a uniform potential in the distributing circuit by varying the speed of a small motor driving a small generator, the current from which is opposed to the field exciting current of the generator.

746,095. SWITCHING APPARATUS; William Kaisling, Chicago, Ill. App. filed May 7, 1903. Means are provided whereby but one of the keys associated with a given cord circuit may be operated at a time, thus avoiding confusion in the operation of the keys on a party line system.

746,128. ELECTRIC HEATING ELEMENT: James F. McElroy, Albany, N. Y. App. filed Aug. 31, 1901. A spiral core of insulating material upon which the resistance coil is wound, is made in skeleton form to afford good circulation of air.

746,140. AUTOMATIC CURRENT CONTROLLING DEVICE; Percy R. Owens, New York, N. Y. App. filed April 18, 1903. Means for gradually increasing the potential of a battery charging current and finally cutting off the charging circuit when the battery is fully charged.

746,153. COMBINED CURB AND CONDUIT; Richard Raby, York, Pa. App. filed May 2, 1903. Details.

746,160. TROLLEY GUARD AND FINDER; William F. Reichenbach, Rochester, N. Y. App. filed June 13, 1903. Lateral arms projecting from the fork have elongated inclined rollers to receive the wire in case it becomes displaced and return it to the wheel.

746,210. TELEPHONE BRACKET; Henry S. Waite, Columbus, Ohio. App. filed Feb. 20, 1903. (See page 1008.)

746,227. ELECTRIC BATTERY; Sakizo Yai, Tokio, Japan. App. filed May 21, 1903. (See page 1008.)

746,273. AUTOMATIC CUT OUT; Charley A. Borein and Louis P. Desimone, Oakland, Cal. App. filed May 11, 1901. A shunt to a translating device contains a circuit controller which affects a main circuit controller in a second shunt around the first.

746,289. STORAGE BATTERY; Rufus N. Chamberlain, Depew, N. Y. App. filed May 13, 1901. Pipe coils conveying heating fluid from one cell to another are coupled together by insulating couplings.

746,314. TELEPHONE SWITCHING APPARATUS; Nels August Engstrom, Chicago, Ill. App. filed Nov. 10, 1902. (See page 1008.)

746,316. ELECTRIC FIXTURE TRIPOD BOX; John E. Ercanbrack, Woodstock, Ill. App. filed March 23, 1903. A box having an opening for the passage of wires and other openings to receive a tripod of a chandelier base.

746,351. TROLLEY; Frank A. Merrick, Johnstown, Pa. App. filed March 12, 1902. Strap springs carried by the wheel pass through holes in the hub and rub against the fixed axle to give good contact.

746,361. ELECTRIC LIGHTING SYSTEM; James E. McElroy, Albany, N. Y. App. filed Oct. 6, 1902. A magnet controlling the dynamo regulator, receives current from both the lamp and the battery circuit, an opposing magnet being placed in the lamp circuit only.

746,362. INSULATOR HANGER OR BRACKET; George H. McFeaters, Johnstown, Pa. App. filed Jan. 30, 1903. A clamp adapted to engage the web portion of steel beams.

746,395. UNDERRUNNING TROLLEY FOR ELECTRIC RAILWAYS; Charles A. Singer, Larchmont, N. Y. App. filed Feb. 7, 1902. Two trolley wheels are carried at the end of the pole, either of which can be thrown into service at will.

746,417. APPARATUS FOR USE IN ELECTRIC TRACTION ON THE CONDUIT SYSTEM; Edouard Vedovelli, Paris, France. App. filed April 7, 1899. Relates particularly to the construction of a conduit and to the protecting and covering of the conductor therein.

746,424. TROLLEY POLE; Thomas F. Wetton, Newark, Ohio. App. filed Aug. 29, 1903. Details.

746,436. HANGER FOR TROLLEY WIRES; Juan Antiga, Mexico, Mexico. App. filed July 1, 1903. The hanger consists of two hinged parts, the ends of the wire being attached to each part; in case the wire breaks the corresponding part is tilted and operates a circuit controller which renders the fallen wire dead.

746,437. HANGER FOR TROLLEY WIRES; Juan Antiga, Mexico, Mexico. App. filed July 1, 1903. A modification of the preceding invention.

746,450. BRUSH HOLDER; Henry K. Brooks, New York, N. Y. App. filed Feb. 24, 1903. Details.

746,463. ELECTRIC CONDUCTOR; Charles M. Clark, South Orange, N. J. App. filed Dec. 10, 1902. A switching device for telphers consisting of means for breaking the circuit through the motor when it passes in one direction and for maintaining the circuit when passing in the other direction.

746,469. ELECTRICAL WIRE SUPPORT; Beauregard Cullen, New Albany, Ind. App. filed May 20, 1903. Details of an insulator.

746,483. ELECTRICAL RECEPTACLE; Philip H. Fielding, New York, N. Y. App. filed Nov. 17, 1902. The receptacle consists of two porcelain parts, one of which carries the metallic connection and is secured to the support by a single central screw, it being prevented from twisting by a rib in the support entering a groove in the porcelain. The cover or protecting shell is held in place by spring clips.

746,490. CIRCUIT-BREAKER FOR STORAGE BATTERIES; Henry Garrett, Dallas, Tex. App. filed June 26, 1903. (See page 1008.)

746,512. ELECTRIC RAILWAY; Robert Hubner, New York, N. Y. App. filed Dec. 19, 1902. A cover plate for a third rail is built in sections which are lifted successively by a plow preceding the collector.

746,514. ELECTRIC BATTERY; Miller Reese Hutchison, Norwood, N. J. App. filed Nov. 15, 1902. (See page 1008.)

746,556. COVER FOR THIRD RAILS; Harry C. Morgan, Lagrange, Ill. App. filed May 9, 1903. The cover consists of a box in two parts hinged to a suitable support and swung open by the action of a plow carried by the car.

746,557. RECEIVER FOR WIRELESS COMMUNICATION; George Morin, Havana, Cuba. App. filed Jan. 20, 1903. The movable core of a magnet forms one terminal of the granular body; the local current traverses a coil which moves the core and causes the particles to decohere.

746,558. SYSTEM OF ELECTRICAL REGULATION; Morris Moskowitz, New York, N. Y. App. filed Jan. 21, 1903. Comprises a generator having a shunt field through which a circuit of a given current carrying capacity is established by means of resistance independent of the field, and variable means connected to shunt away a part of the current in the field circuit.

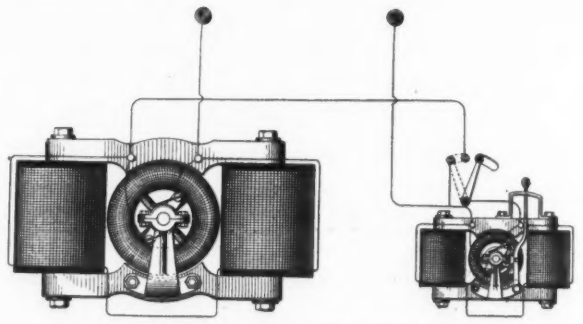
746,577. ELECTRIC SWITCH; Alvin Riverburgh, Greenfield, Iowa. App. filed March 6, 1903. A number of switches are supplied to a house depending upon the maximum number of lamps which it is desired to use at any one time; each switch can cut in any one lamp of the entire number of lamps in the house.

746,580. ELECTRICAL CONNECTION; Frank J. Russell, New York, N. Y. App. filed Aug. 13, 1903. Details.

746,587. MULTICIRCUIT CONTROLLER; William M. Scott, Philadelphia, Pa. App. filed March 10, 1902. A plurality of circuit controllers so arranged that upon abnormal conditions obtaining in any one or more of the circuits to be controlled, the entire group of controllers operates together.

746,601. ELECTRIC ARC LAMP; Marion A. Stogsdill, Indianapolis, and Edward J. Schatz, Greenfield, Ind. App. filed Dec. 20, 1902. Details of a headlight lamp.

746,604. CIRCUIT CLOSING DEVICE; Oliver B. Thompson, and William G. Midgley, Buffalo, N. Y. App. filed June 2, 1901. A thermal circuit closer for alarm circuits.



12,180.—Method of Controlling Electric Motors.

746,614. TROLLEY POLE; Edwin A. Wakefield and George W. Morse, Mechanic Falls, Me. App. filed July 8, 1903. A device to prevent the pole from flying upward when the wheel leaves the wire.

746,624. SWITCHBOARD; James B. Wood, Gate City, Va. App. filed Oct. 16, 1902. Travelers are mounted on tracks arranged above the face of the board, the travelers engaging with contacts in the face of the board beneath them.

746,628. DOWEL PIN FOR CONDUIT SECTIONS; Cornelius J. Field and Lewis J. Doolittle, Brooklyn, N. Y. App. filed July 24, 1903. The dowel pin is half of one diameter and half of another, the object being to prevent its displacement.

12,179. MEANS FOR CONTROLLING ELECTRIC MOTORS; Montgomery Waddell, New York, N. Y. App. filed Jan. 15, 1901. In place of the usual controlling resistances, a small secondary motor has its armature connected in series with the armature to be regulated and the counter-electromotive force of the secondary motor is controlled to vary the current flowing to the main motor.

12,180. METHOD OF CONTROLLING ELECTRIC MOTORS; Montgomery Waddell, New York, N. Y. App. filed Jan. 15, 1901. Relates to the subject matter of the preceding patent.